AUGUST 1960

Power Engineering

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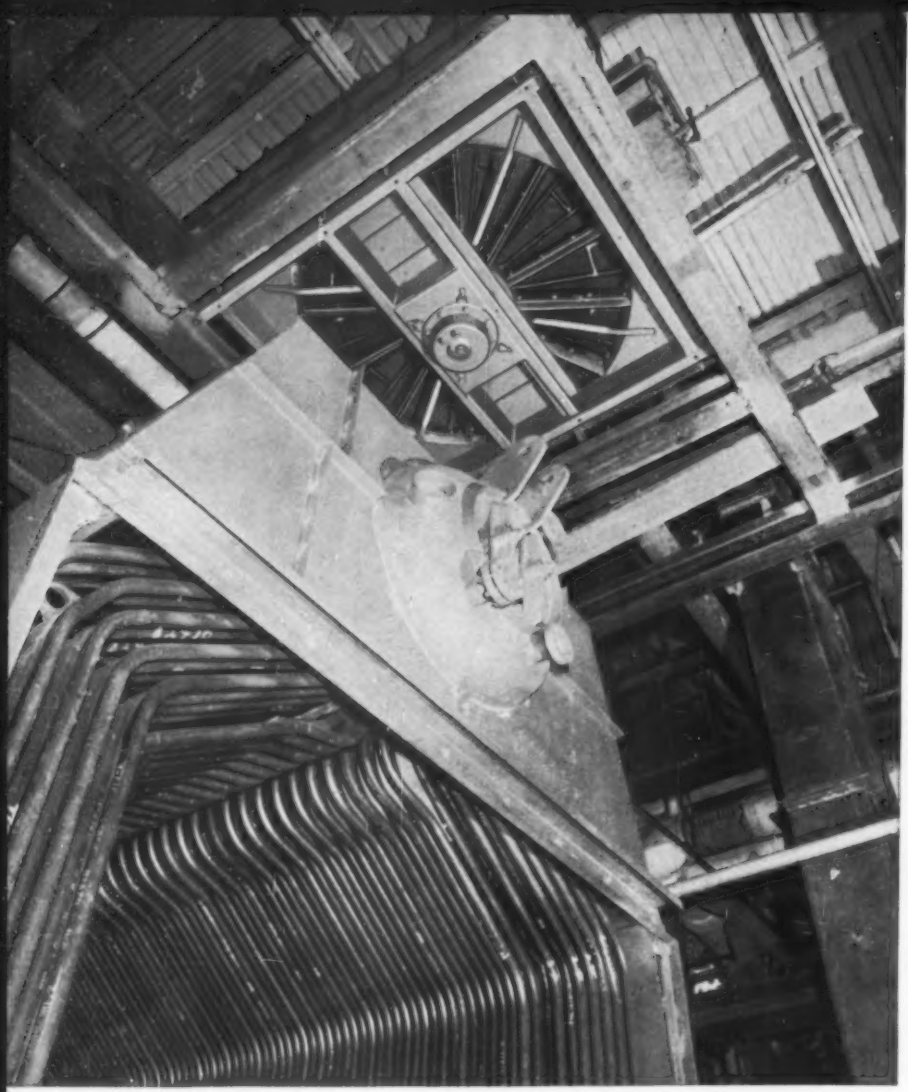
EXCLUSIVELY FOR POWER ENGINEERS
IN EVERY FIELD WHERE POWER IS USED



The Ljungstrom Air Preheater at the B. F. Goodrich Company Shelton Plant is installed directly over the 65,000 lb/hr Wickes boiler. Flue gas leaving the boiler at 615°F passes through the circular rotor, which absorbs the heat and releases it into the incoming air. Preheated combustion air improves combustion, makes fuel burn cleanly. This Package Air Preheater was factory-assembled, and requird only 100 manhours to install.

At B. F. Goodrich Co.'s Shelton Plant

Air Preheater boosts combustion air temperature 345°F... gives 6% more thermal efficiency

"Only a Ljungstrom® Air Preheater, with its continuous regenerative principle, could meet our requirements", says A. G. Sandomirsky, Manager of Engineering at the B. F. Goodrich Company, Shelton, Conn., plant. "We produce foam rubber 24 hours a day, five and six days a week. With an Air Preheater we can meet process steam requirements more economically, and an Air Preheater helped us to justify the installation of high efficiency, high pressure equipment for by-product power generation."

Here's why the Shelton plant meets its requirements best with a Ljungstrom Air Preheater:

1. Ljungstrom is the most efficient heat exchanger you can buy. The Ljungstrom rotor revolves continuously through the flue gas and incoming air, thus absorbing heat and releasing it *from the same surface*. Since the heat doesn't have to pass through anything, each inch of rotor surface is as efficient as one foot of a tubular recuperator.

2. Ljungstrom is the most reliable heat exchanger you can buy. All heat exchange elements pass through the entire air and gas streams. The temperature of the elements in the coolest region — where fresh air enters — is actually an average of the gas and air temperatures, so it's consistently higher than the coolest point in a recuperative heat exchanger. Result: no cold spots, less chance of moisture formation.

3. Ljungstrom is easiest to maintain. You can inspect it — and clean it—while it's running. Heat exchange elements are divided into modular baskets that can be replaced individually without disturbing the other elements. You can even reverse the elements if the surface has thinned on one edge, effectively doubling the life of the heat exchange surface.

For more information on the Ljungstrom continuous regenerative principle, or on the Air Preheater that meets your requirements, phone MUrray Hill 2-8250 or write to The Air Preheater Corporation.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

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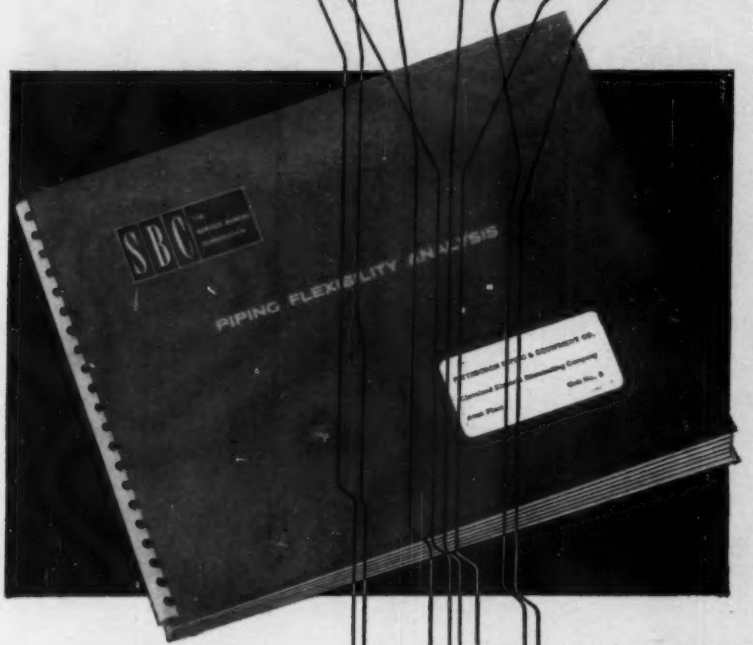
Announcing a major advance in Piping Technology...

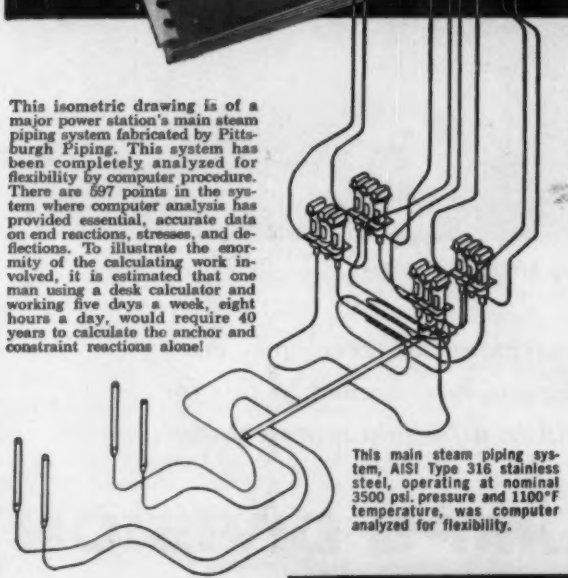
COMPUTER ANALYSIS OF FLEXIBILITY OF COMPLEX POWER PIPING



An efficient computer analysis of the physical reactions of a complex piping system which will occur in actual operation is now a reality! This remarkable achievement in piping technology is the result of a three-year project initiated by Pittsburgh Piping with The Service Bureau Corporation, a subsidiary of IBM. It utilizes the incredible speed and "memory" of today's electronic computers to make literally millions of calculations which provide a complete solution of end reactions, stresses, and deflections.

But, the computer is only a tool – the essential factor in the success of computer analysis of power piping flexibility is the ease of preparing input data. In this phase, the programming and analytical resources of The Service Bureau Corporation together with the experience of Pittsburgh Piping in the power field has led to the success of this program. We shall be glad to discuss this development with you, as it applies to a power piping or similar installation.

This isometric drawing is of a major power station's main steam piping system fabricated by Pittsburgh Piping. This system has been completely analyzed for flexibility by computer procedure. There are 597 points in the system where computer analysis has provided essential, accurate data on end reactions, stresses, and deflections. To illustrate the enormity of the calculating work involved, it is estimated that one man using a desk calculator and working five days a week, eight hours a day, would require 40 years to calculate the anchor and constraint reactions alone!



This main steam piping system, AISI Type 316 stainless steel, operating at nominal 3500 psi. pressure and 1100°F temperature, was computer analyzed for flexibility.

UNIQUE FEATURES

- Provides accurate, advance knowledge of reactions, stresses, and deflections at **every** vital point of a power piping system.
- Enables designer to have **complete** flexibility analyses made of **several** piping layouts in less time at less cost than formerly has been required to check one design partially.
- Can be used to pre-determine the physical reactions of **any** piping system, made of **any** material or combination of materials, for operation at **any** temperature or pressure.
- Accounts for every movement or complex of movements.
- Skillfully programmed, it is a thoroughly dependable, remarkably effective method for the piping engineer to use in designing an optimum system which results in reducing the overall cost of building and operating a power station.

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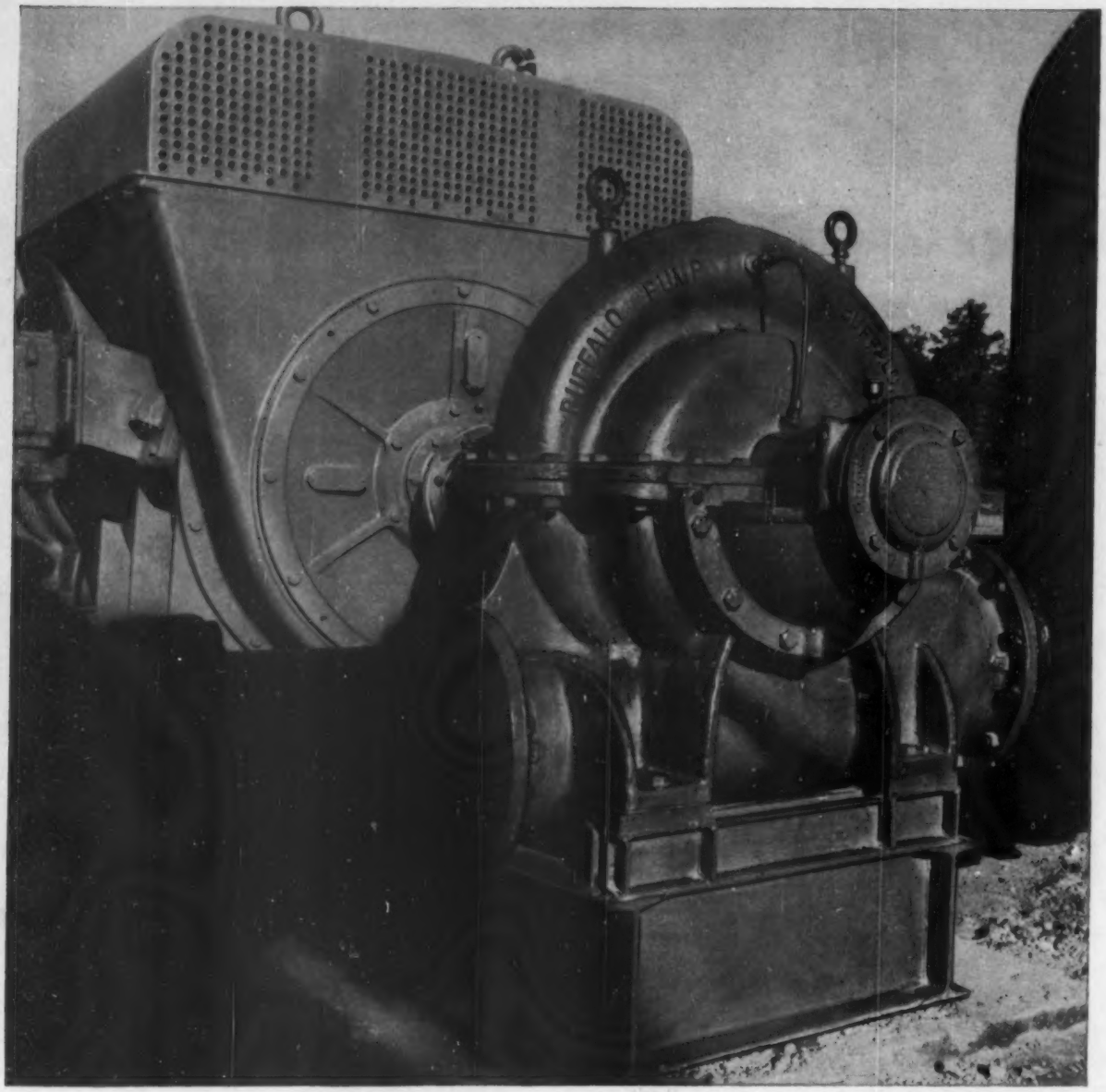

1 of 3 'Buffalo' Pumps delivering a total of 13 to 15 MGD to a major paper mill day after day.

Big pumps, small pumps, in most materials, every job, every industry—our Buffalo Pumps Division has excelled in this for over 83 years. Write direct or call in a Buffalo representative.

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Buffalo air handling equipment to move, heat, cool, dehumidify and clean air and other gases.

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Buffalo Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

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Engineers' Preview

OF NEWS AND COMING EVENTS IN THE POWER FIELD

OKLAHOMA GAS & ELECTRIC will have the nation's largest combined cycle steam-gas turbine electric power generation station. Contract for an addition which will add more than 200,000 kw to Horseshoe Lake Station has been awarded to General Electric. Sargent & Lundy will design the plant, which will be completed in 1963. It is expected to be at least 4 per cent more efficient than a comparable conventional power plant of similar capacity.

In the combined steam-gas turbine cycle, the gas turbine not only supplies power for its own generator, but also supplies preheated combustion air to the boilers, where the exhaust heat is utilized.

BOILER ROOM GUIDE to the efficient operation of spreader stokers has been published in chart form by the Bituminous Coal Institute. The chart (17 by 22 inches) is printed in large, readable type and on heavy paper stock punched for wall mounting. Copies are available by writing to the Bituminous Coal Institute, Coal Building, 1130 17th St, N.W., Washington 6, D. C.

CONSOLIDATED EDISON has ordered two large steam boilers from Combustion Engineering, to be installed at the company's new Ravenswood Station in New York City. The boilers will generate steam for two 357,000-kw turbine generators, one of which will go into operation in 1963, the other in 1964. Towering nearly 17 stories high, the boilers will burn gas or oil initially. Provisions are being made to burn pulverized coal in the future.

At Ravenswood, steam will be supplied to the turbines at 1050 F and 2250 psig with reheat to 1000 F. Tilting tangential burners will automatically maintain steam temperature constant from 2,500,000 lb per hour down to 1,500,000 lb per hour.

COAL SAMPLER has been placed in service at TVA's Kingston Steam Plant which mechanically collects a representative sample from truckloads of coal for quality analysis by the laboratory. Consisting of a hollow tube, the sampler is pushed into the coal pneumatically. Auxiliary force is furnished by an ordinary air hammer or pile driver. Upon reaching its maximum depth, two hinged leaves at the bottom of the sample tube are forced together, closing the bottom and encasing all the coal in the tube.

After the tube is withdrawn and moved to the sample discharge hopper, the leaves are separated, and the coal falls from the tube for the processing preceding analysis. Observation of the coal as it falls from the tube will disclose layer-loading and coal of inferior quality.

NEW 13-story apartment house planned for Philadelphia is expected to be the largest all-electric apartment house in the United States. The 132-unit structure will feature all-electric heat, cooling, lighting and appliances. It will be named the "Iroquois" and will be located at 47th St and City Ave.

JACKSONVILLE, Fla, has awarded Leeds & Northrup a contract totaling approximately $125,000 for a new electronic brain which will enable the city to produce more power from less fuel. Known as an advanced generation controller, it will cut costs by maintaining each unit at its most economical operating level regardless of load demand. The controller will also evaluate whether the municipality can sell power at a profit through a tie-line system with neighboring utilities.

UNITED NATIONS Special Fund has allocated $2,361,400 for a survey of potential hydropower sites in India. An additional hydropower capacity of 2.8 million kw during the third five-year plan period from 1961 to 1966 and of 5 million kw during the period of the fourth five-year plan is called for in India's present development programs. On the basis of available topographic and hydrological data, 64 sites, with a total capacity of 12 million kw, have been tentatively selected for development.

$1,246,250 CONTRACT for the construction of a one million-gpd sea water conversion demonstration plant at Freeport, Texas, has been awarded by the Office of Saline Water of the Dept of the Interior to the Chicago Bridge and Iron Co. The Freeport plant is the first of five saline water conversion plants authorized by Public Law 85-883. Process to be utilized in this plant — long-tube vertical multiple effect distillation — incor-

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porates several newly developed technical innovations resulting from OSW-sponsored research. The plant is expected to produce fresh water from the sea for less than $1 per thousand gallons.

C. H. WHEELER MFG CO and GRISCOM-RUSSELL CO have combined. Both are subsidiaries of Hamilton-Thomas Corp.

Milestone of 30-billion kwh of net generation has been reached and passed by the American Electric Power system. AEP became the first private electric utility system in the world to reach this level when it generated 30,027,858,000 kwh during the 12 months ended April 30. As a measure of comparison, 30 billion kwh is the equivalent of the amount of electricity used in a year by 8 million average American homes. Or, given another way, this is equal to burning 34,278,300 bulbs of 100 watts each continuously for one year.

SOLID-STATE Metrotype information system purchased recently by Public Utility District No. 1 of Chelan County, Wash., for its new Rocky Reach Hydroelectric Power Project will be completely programmed by a magnetic drum. Made by Bailey Meter Co, it is reported to be the first industrial application of magnetic drum programming to a digital data-gathering, alarm scanning, and logging system. System will measure and scan continuously 110 variables, one per second, and log out all points once an hour or on demand.

THE Engineering Index — 1959 75th edition, has been published by the Engineering Index, Inc, 29 W. 39th St, New York 18. It contains over 39,100 annotations of articles reviewed in some 1700 publications. Price is $70, postpaid.

WHILE SOME NUCLEAR fuel elements themselves reach temperatures above 4000 F in the fission process, nuclear scientists can get only about 600-deg temperatures out of the fuel elements and into the surrounding water. This limits the heat which can be taken from the fuel.

To use nuclear heat energy at the higher temperatures, Westinghouse has built an experimental fuel element with a thermionic generator in its center and a thermoelectric generator surrounding it. A thermionic generator operates at about 3500 F, but will not function efficiently at temperatures below 2700 F. A thermoelectric unit, on the other hand, does not operate at such elevated temperatures, but works well in the temperature range of 600 to 1800 F.

By putting the two types of generators in tandem, the heat passing through the thermionic generator flows through the thermoelectric unit. The elements are wired in series to give a combined electrical output over a very wide temperature range.

ARIZONA PUBLIC SERVICE will build a new 110,000-kw steam electric generating station near Joseph City, Arizona, at a cost of about $19 million. Pittsburg & Midway Coal Mining Co will supply the plant's needs from its extensive coal reserves in New Mexico. The new plant will be known as the Cholla Power Plant and is scheduled for completion by late spring of 1962.

LARGEST application of aluminum rigid conduit in the West — some 38 miles in all — is scheduled for the Wanapum Dam development on the Columbia River near Vantage, Washington. Installation will be done by the Engineering & Construction Co, using conduit from 1¼ to 5 inches in diameter supplied by Kaiser Aluminum & Chemical Sales. Wanapum Dam will furnish power to the Grant County Public Utility District and nine other public and private electric utilities in the Northwest. When completed in late 1964, the project will include 10 generators with a total nameplate rating of 831,250 kw.

SWEDISH company Jonkopings Mekaniska Werkstad (JMW) has concluded a license agreement with Foster Wheeler, Ltd, of Ontario, under which the Canadian company is to build JMW pulp mill soda recovery boilers in Canada. The two companies have obtained a $1,000,000 order for such a boiler from Nova Scotia Pulp Ltd, the new sodium bisulphite pulp mill to be built in Canada by the Swedish Stora Kopparberg Co.

HENRY VOGT MACHINE CO of Louisville, Ky, has been named winner of the General Electric Co's contest to find the oldest operating dry-type, general-purpose transformer. Winning entry was installed on February 22, 1934, and is still in operating condition. The transformer is a 37½ kva, single-phase unit for transforming 230/460 volts to 115/230 volts.

NORTON CO has successfully made diamonds. Basic ideas for equipment and processes were formulated and carried forward to successful conclusion by a team of Norton researchers headed by Loring Coes, Jr, assistant director of research and development, and Dr. Paul P. Keat, senior research engineer.

MEETINGS: 4th national Heat Transfer Conference and Exhibit, Aug. 14–17, Statler Hilton Hotel, Buffalo, N. Y. Sponsored jointly by ASME and AICE.

Production Engineering Show, Sept 6–16, Chicago's Navy Pier, running concurrently with the Machine Tool Show at the International Amphitheatre.

2nd International Coliseum Machinery Show, Sept 7–15, Chicago.

National Power Conference, Sept 21–23, Bellevue-Stratford Hotel, Philadelphia. Sponsored by the Power Divisions of ASME and AIEE.

National Fall meeting of the American Welding Society, Sept 26–29, Hotel Penn-Sheraton, Pittsburgh.

American Rocket Society's Space Power Systems Conference, Sept 27–30, Miramar Hotel, Santa Monica, Cal.

42nd National Metal Congress and Exposition, Oct 17–21, at the Convention Halls and Bellevue-Stratford Hotel, Philadelphia. Sponsored by ASM.

International Congress and Exhibition for Instrumentation and Automation, Oct 19–26, at Dusseldorf, Germany.

23rd annual Joint Solid Fuels Conference, Oct 24–25, at the Daniel Boone Hotel, Charleston, W. Va. Sponsored by ASME and AIME.

The American Brass Company
Waterbury 20, Conn.

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4 ways to cut the cost of high-conductivity parts

There are now four free-cutting, high-conductivity Anaconda coppers that broaden the combinations of mechanical, physical, and fabricating properties available for boosting production and cutting costs of high-conductivity parts. They are furnished chiefly in rod and bar, but are available also as extruded shapes and, except for the leaded coppers, die-pressed forgings of simple design. All have good cold-working properties.

Leaded Copper-126 and Deoxidized Leaded Copper-129 have slightly higher electrical conductivity—98% IACS annealed, 95% IACS, minimum. The difference between them is that Alloy 129, being deoxidized, is not subject to hydrogen embrittlement when annealed or furnace-brazed in reducing atmospheres. Neither leaded alloy is recommended for hot working.

Tellurium Copper-127 and OFHC* Sulfur Copper have an electrical conductivity rating of 95% IACS annealed, 90% minimum. Both may be extensively hot worked and neither is subject to hydrogen embrittlement. Tellurium Copper-127 has the advantage of retaining its mechanical properties at temperatures higher than those tolerated by the other free-cutting coppers—and hence is widely used in the welding and cutting-tip field.

The free-cutting coppers may be machined at cutting speeds approaching those used for machining Free-Cutting Brass. For Tellurium Copper-127, however, carbide-tipped tools are recommended as the inherent copper telluride particles cause somewhat greater tool wear.

*Registered Trademark of American Metal Climax, Inc. 6047 Rev.

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Tracers

COMMENT, OPINION, AND NEWS ABOUT PEOPLE

▶ **Harold Rolph,** a stationary engineer who lives and works in London, Ontario, is a regular reader of POWER ENGINEERING and doesn't mind saying so. Rolph writes us:

> I read your magazine every month and appreciate it very much. It helps me greatly in my capacity as a stationary engineer, as many of the articles are so fine. I particularly find those on plant and equipment maintenance and repair — also on how equipment should be handled — to be very valuable to me. I particularly like the articles on maintenance, as they do not over-generalize on the subject, but go deep enough and are simply written.

▶ **Allen S. King,** of the Northern States Power Co and president of Edison Electric Institute, points out that last year the electric companies had nearly 112,000,000 kilowatts in conventional steam plants and about 12,500,000 in hydro plants. Nuclear plants provided 65,000 kw. By 1980, steam capability should reach nearly 417,000,000 kw, he says, with hydro about 25,000,000 and nuclear some 39,000,000 kw.

▶ Levacar, the land vehicle that may some day travel from city to city at 500 mph, sliding on a thin film of compressed air, may be closer to reality than you think. **Alex L. Haynes,** of the Ford Motor Co, says his company has already built experimental levacars and is continuing to develop the idea. Said Haynes at a recent ASME meeting in Dallas:

> To date, we have established the feasibility of the system and are continuing to develop the technology. Fundamentally, a levacar is an airplane except that in flying very close to the ground it needs neither wings nor tail surfaces.
>
> Any lightweight engine is satisfactory as a source of power, and the same engine can also be used to provide the compressed air for the levapads. Power consumption will be much less than for aircraft, and since a driver is not needed with fully automatic control, operating costs for levacars should be substantially less than for comparable aircraft.

Leaving from downtown terminals, and eliminating travel from and to remote airports, such vehicles could cut hours from intercity travel time.

▶ Jacob Ruppert brewery in New York City has gone automatic. A process controls system, engineered by Minneapolis-Honeywell's Brown Instruments Div, has been installed primarily to solve a manpower problem, but is paying off in other ways. Explains **Mortimer W. Brenner,** vice president and director of brewing:

> Ruppert's problem was that of a labor contract change from 8-hr to 7-hr shifts. This decrease upset the normal clock schedule of four brews every eight hours. Continuous brewing dictated that we either add manpower considerably in excess of our requirements, or make our operations, even to the adjustment of valves, as automatic as possible.
>
> Brewing is still subject to human error and variations where instruments and controls are not used. At Ruppert these individual variations have been eliminated. The control system, pushbutton operated, is centralized on two panels of six instruments each. The devices record or control the process variables of temperature, pressure, liquid level and flow.

▶ **Frank C. Mullaney,** general manager of Control Data Corp's Computer Div, reports that the company has established a computing center at its Minneapolis home office. Computing time on a service-bureau basis will be available to organizations with problems which require the capabilities of the large-scale 1604 or the intermediate-scale 160 solid state digital computers.

▶ **Jack L. Schumann** has been elected president and a director of Buell Engineering Co.

Stone & Webster Engineering Corp gets two new vice-presidents, in **Theodore E. Casselman, Jr,** manager of the firm's New York office, and **Wilbur S. Roberts, Jr,** manager of new business activities. **Frank C. L. Sperry** and **Edgar M. Hawkins, Jr,** have been elected vice-presidents of Stone & Webster Service Corp.

A. Allan Bates, vice-president of research and development of the Portland Cement Assn, Chicago, has been elected president of the American Society for Testing Materials. ASTM has conferred the 7th Max Hecht Award on **Frank N. Speller** for his work on corrosion as it involves action of water on steel.

Noah E. Hull of Houston, Texas, has been elected president of the National Society of Professional Engineers. Hull is vice-president and general manager of the Hughes Gun Co and assistant to the vice-president, manufacturing, of Hughes Tool Co.

Meeting in Stockholm, Sweden, in June, the Federation Internationale des Ingenieurs-Conseils named **Edward J. Wolff** of Chicago to its executive committee. Wolff, along with **William W. Moore** of San Francisco, represented the Consulting Engineers Council of the U. S. at the international meeting in Stockholm.

Joseph B. Elliott has become president and general manager of the York Division of Borg-Warner.

Walter H. Zinn, vice-president in charge of nuclear activities of Combustion Engineering, has been named a Fellow of the American Nuclear Society. Zinn is also the recipient this year of the Ford Motor Co's Atoms for Peace award, which carried an honorarium of $37,500.

Appointed to serve as director of advertising and public relations for Babcock & Wilcox Co is **M. E. Ziegenhagen,** who has occupied the same post at G-E and at Worthington.

Hall Industrial Water Report

VOLUME 8 AUGUST 1960 NUMBER 4

You Don't Need a Crystal Ball

There are times when you wish that a look into a crystal ball would tell you what is happening in boiler tubes, turbines, water lines, heat exchangers and condensate systems. Are deposits forming? Is corrosion occurring?

Actually, you don't need the crystal ball. Simple water tests will usually tell you what is going on—whether water conditions are satisfactory for control of deposit formation and corrosion or whether changes should be made in chemical treatment to avoid trouble.

Interpretation of water analyses is everyday business to Hall Laboratories engineers. One of their functions is to teach operating personnel the test procedures and what the resulting numbers mean. And the Hall engineers can help you in many other ways to keep your plant operating with a minimum of water problems—in boilers as well as in cooling, process or waste disposal systems.

Water Not Responsible

Just when operation of a new boiler in a Canadian plant was well under way there was trouble. After six months' operation a side wall tube failed due to cracking. Then three months later another cracked.

Water conditions were blamed. The Hall engineer was called in. He was able to show that satisfactory water conditions had been maintained because the operators he had trained had conscientiously carried out the chemical feeding and testing program. Furthermore, metallographic examination of specimens from the cracked tubes showed that the problem was corrosion fatigue. This pointed to alternate overheating and quenching which could only result from discontinuous cooling by the water.

More water to the side wall tubes was provided by the installation of additional water supply tubes. Cracking stopped and the boilers have now operated more than three years without an unscheduled outage.

From Heat Pumps to Dishwashers

Diverse types of equipment including heat pumps, hot water boilers, steam boilers and cooling towers were utilized for heating and cooling in a county school system. Hall Laboratories was retained to tackle the numerous scale and corrosion problems. In addition to equipment, more than fifteen miles of piping were involved, some of it buried in concrete.

Hall field engineer H. V. Gedney made a thorough survey of water usage and equipment at each school. A water conditioning program was then initiated at each and responsible personnel attended a water treatment school conducted by Gedney.

Good results followed. After a year's operation corrosion was found to be greatly reduced. Scale problems had disappeared. But water always causes trouble—Gedney was asked next to solve the problem of corrosion and deposition in the dishwashing machines.

Hunting Iron

Heavy accumulation of iron oxide in boilers at a municipal power plant made necessary frequent cleaning of the boilers. Since tests showed that the iron was entering the boilers in the feedwater, Hall field engineer E. R. Lang recommended increasing pH value of condensate and feedwater by use of a neutralizing amine (Hagamin®). This would minimize corrosion in preboiler equipment and piping and thus reduce iron content of the water.

Reduction of iron concentration was not as great as expected. Further testing led to the discovery that the main source of iron was the zeolite-softened makeup water which came from the treated water storage tank. Iron concentration of this stored water was more than one hundred times greater than iron concentration of the softened water.

Makeup water is now supplied directly from the softeners. The stored water is used only in emergencies. Iron oxide accumulation in the boilers is no longer a problem.

Dancing Water

When suddenly faced with wildly fluctuating water levels and heavy carryover from the boilers, the operating men at a steel fabricating plant called in Hall field engineer M. E. Osmond. Quick action was necessary so Osmond temporarily quieted the boiler water with a Hagan antifoam. This gave time to hunt the cause of the unusual trouble.

Condensed steam samples collected for conductivity tests were found to contain oil. The first condensate collection tank checked was found to be loaded with oil. Further tracing led to a tank in which quenching oil was heated with a steam coil. The coil was leaking, admitting oil to the condensate.

Once the source of trouble was located, correction was easy. The condensate from the heating coil was diverted to the sewer until repairs could be made.

Water is your industry's most important raw material. Use it wisely.

How Consultants Solve Industrial Water Problems

There are no "stock answers" to industrial water problems. A new 24-page booklet, "Hall Laboratories —Industrial Water Consultants," describes the many ways industry can use water most economically. For a copy of this booklet, write on your letterhead to:

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HAGAN CENTER, PITTSBURGH 30, PA.
Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.

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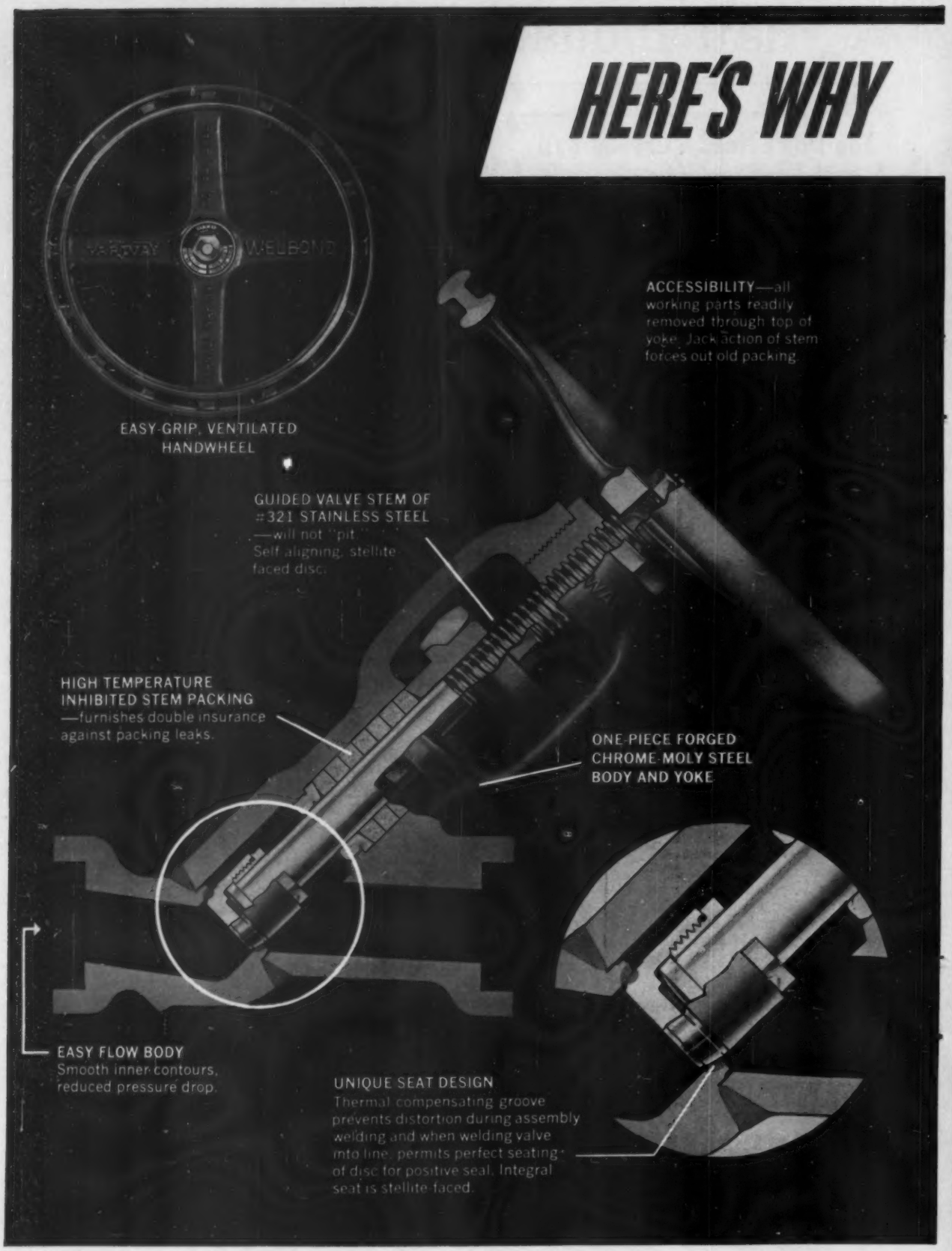
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EASY-GRIP, VENTILATED HANDWHEEL
ACCESSIBILITY—all working parts readily removed through top of yoke. Jack action of stem forces out old packing.
GUIDED VALVE STEM OF #321 STAINLESS STEEL —will not "pit" Self aligning, stellite faced disc.
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WELBOND VALVES—designed specifically to provide better, longer maintenance-free service in high pressure/high temperature power plants—have won resounding acceptance from operators of modern steam plants everywhere. Welbond performance speaks for itself.

Why do Yarway WELBOND valves give these results? Because only WELBOND combines all these valve advantages:

- ✓ Valve stem of 321 austenitic stainless steel prevents pitting. As an added precaution special inhibited packing gives still greater assurance against stem corrosion.
- ✓ Quick *accessibility* of all working parts through top of yoke.
- ✓ Unique seat design with thermal compensating groove provides non-distorting seat, assuring drop tight shut-off. Reseating tools available for quick "on the job" repairs to valve seat.
- ✓ One-piece forged chrome-moly steel body and yoke.
- ✓ Easy-grip, ventilated handwheel.
- ✓ Smooth inner contours, reduced pressure drop.

Yarway WELBOND valves are "proving their mettle" on high pressure boilers in all general services requiring small valves (¼" through 2½").

Try WELBONDS in *your* plant. Write for free Yarway Bulletin B-454.

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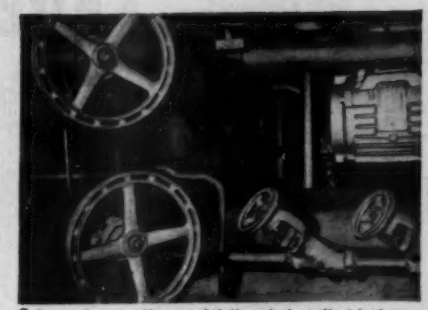
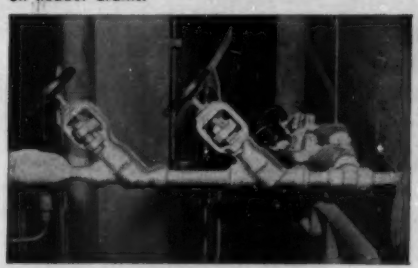
YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

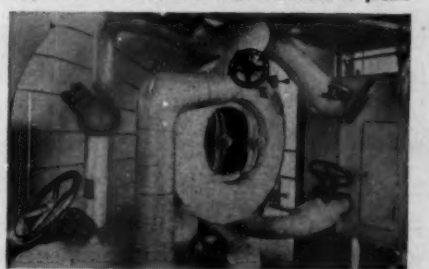


● Four of many Yarway Welbonds installed in large eastern public utility plant. Steam pressure 1850 psi; temperature 1000°F.

● Four of numerous Yarway Welbonds in station of large mid-west utility. These Welbonds installed on header drains.



● Four Yarway Welbonds on main steam line to turbine at southern power plant. Pressure 2310 psi; temperature 1000°F. Over 100 Welbonds in plant.

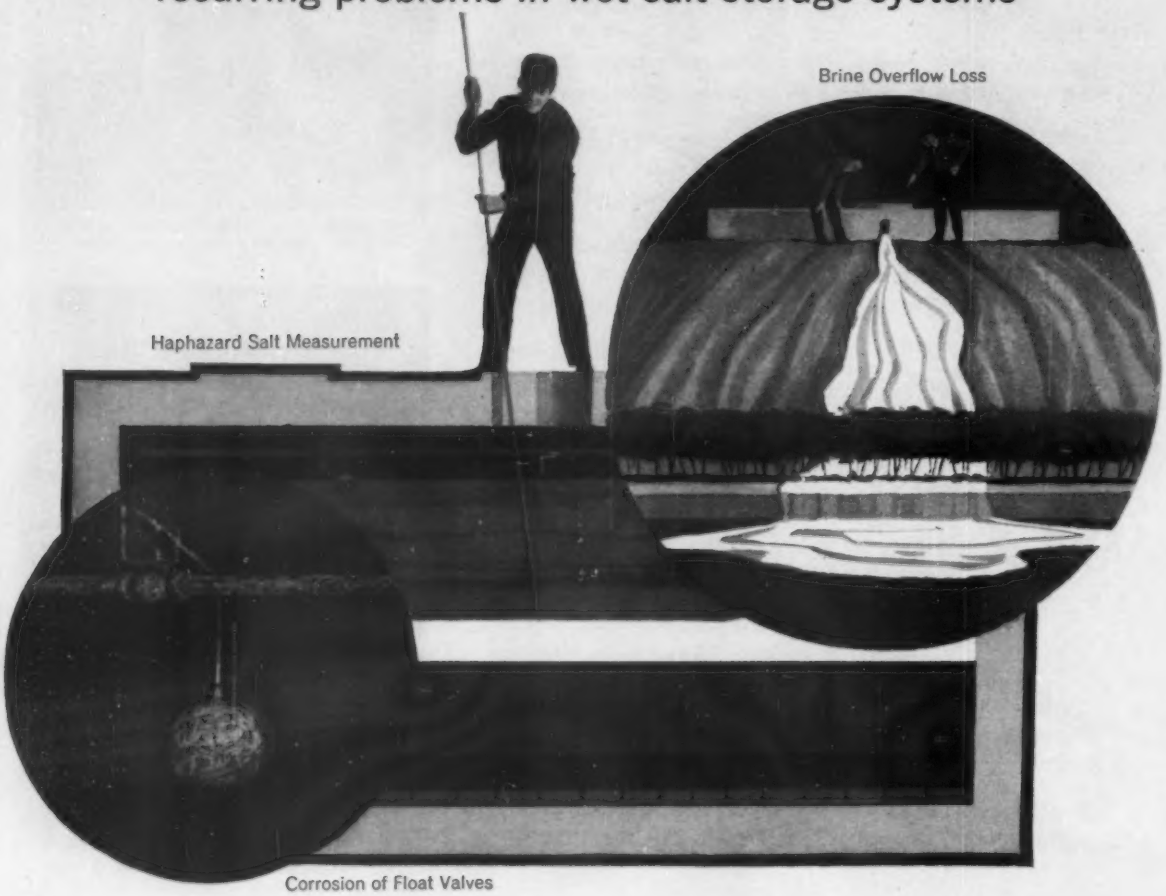


● Six of more than 900 Yarway Welbonds installed in various power plants of southwest utility. Boiler drum pressure in this plant—2150 psi; superheat temperature 1005°F.

For more data circle 506 on Post Card

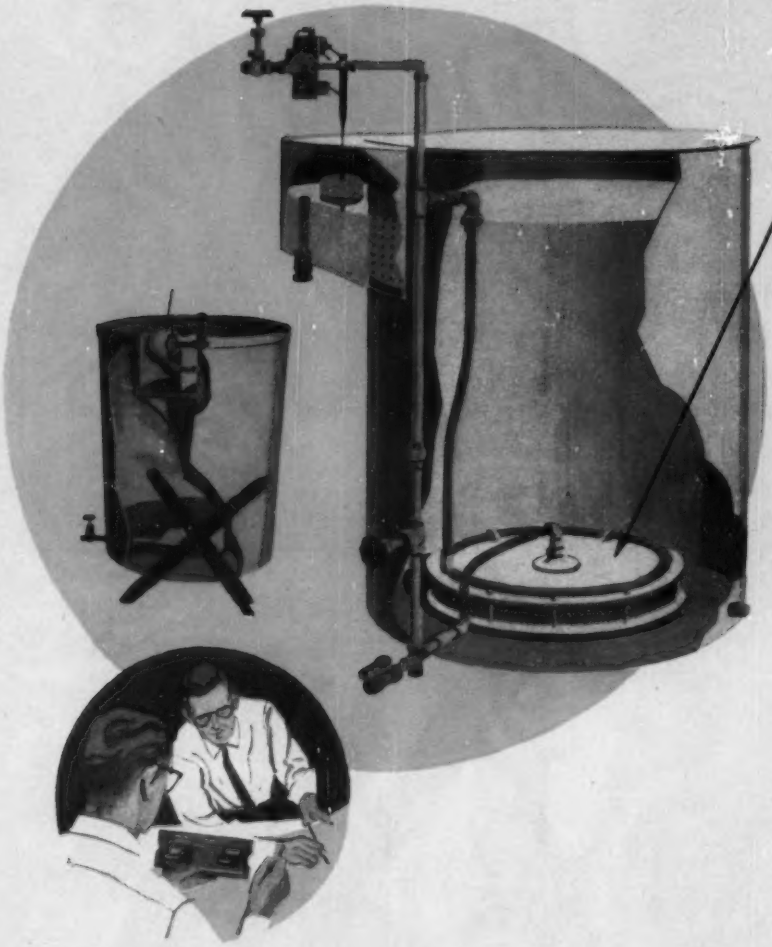
Let Morton help you solve these problems in using salt

New MORTON LEVETROL* system solves these recurring problems in wet salt storage systems



Levetrol is a liquid level control method which automatically replaces water needed in wet salt storage systems in proportion to salt withdrawn in brine form. ¶ Adaptable to most wet salt storage systems, Morton Levetrol protects you from salt losses due to brine overflow by constantly balancing the water level to the salt bed level. ¶ Levetrol also eliminates the troublesome problem of corroding float valves. The simple, dependable Levetrol control system is installed on water lines located away from the wet salt storage. This completely avoids costly corrosion problems and assures you proper brine strength at all times. Levetrol enables you to have complete automation and consistent regeneration of your water treatment system.

*pat. applied for



New Morton "Fluitron" assembly ends gravel problems in your brinemakers.

The all-plastic "Fluitron" is an exclusive Morton brinemaking device which creates exceedingly high brine make-up rates and completely eliminates the need for gravel supporting beds when dissolving high-purity fine grained salts. The "Fluitron" insures a pure, saturated brine when used with Morton '999' or Purex all-soluble salts. The Morton "Fluitron" diffuses water through the salt bed and also collects the brine for discharge to the brine-use system. By eliminating the gravel bed and expanding the salt capacity of your dissolving vessel, the "Fluitron" relieves you of the job of frequent salt charging.

Adaptable to most brine make-up tanks, the "Fluitron" is included with Morton Model E Brinemaker series or you may acquire it individually on convenient leasing terms.

Morton Brinemakers are now available in two corrosion-free materials—stainless steel or plastic.

Morton offers you help in solving problems in design, modification, installation or operation of brinemaking equipment.

All of these problems can be solved with the counsel of one of Morton's Brine Engineers. Their experience with all types of salt for brine using processes can provide you with fresh ideas and the latest techniques in solving these problems. Many architects, engineers and plant superintendents already have found that calling upon a Morton engineer can save time and money.

Problems of salt selection, delivery and handling, can be easily solved by talking to a Morton man. He can tell you which of 100 different grades of salt will do the best job for you. What's more, Morton's nation-wide service and production facilities assure you dependable delivery of the salt you need in the quantity you want, anywhere in the country.

Mail coupon today for information on how Morton can help you solve brine make-up problems!

☐ Please send booklet on Levetrol System. ☐ Please send booklet on new Morton "Fluitron" and Brinemakers. ☐ Please have a Morton Brine Engineer contact me regarding:

(type of problem)_____

Name_____

Title_____

Company_____

Address_____

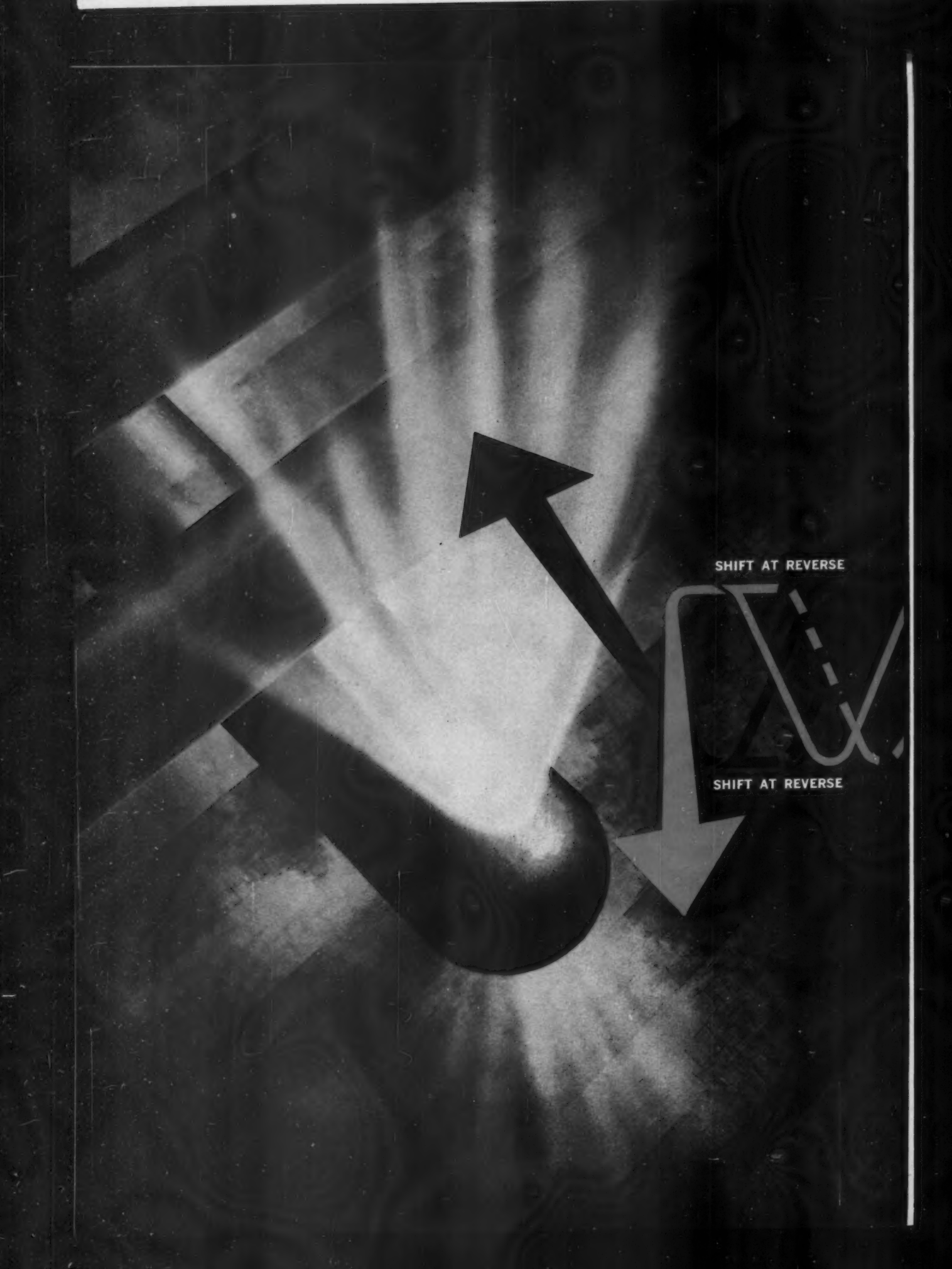
City_____ Zone_____ State_____

MORTON SALT COMPANY

INDUSTRIAL DIVISION

Dept. PE9, 110 No. Wacker Drive, Chicago 6, Illinois

For more data circle 510 on Post Card

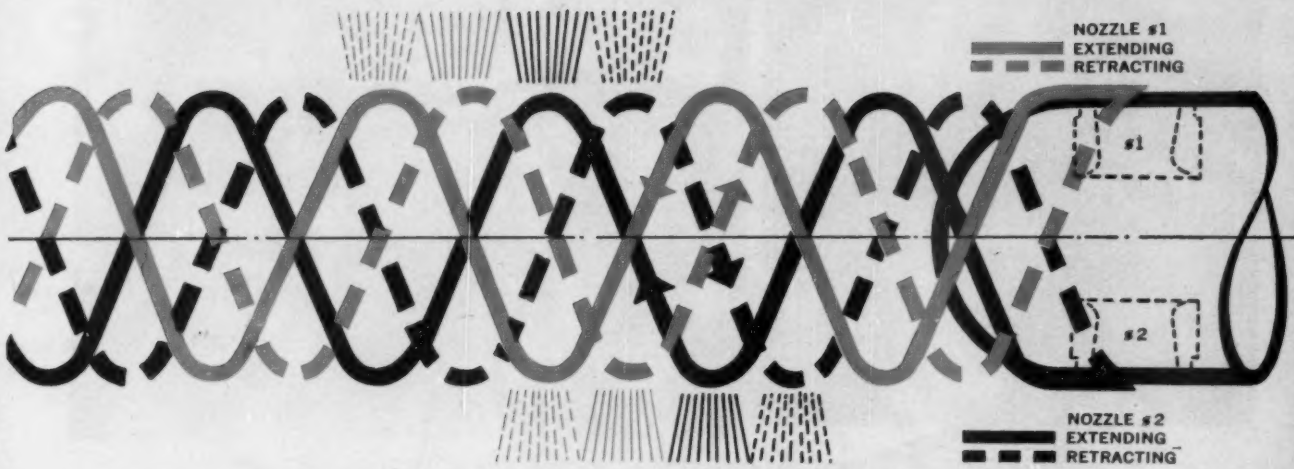

SHIFT AT REVERSE
SHIFT AT REVERSE

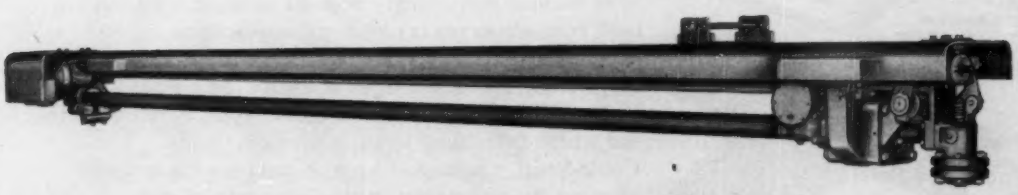
Diamond developed for more economical power...

A CLEAN SWEEP...EVERY INCH OF THE WAY

Get uniform, complete cleaning in those "tough-to-clean" zones. Specify Diamond's IK-300 Retractable Blower. The exclusive close-spaced IK helix assures a penetrating nozzle sweep every inch of travel regardless of tube bank arrangement and tube spacing. What's more, because sectionalized lance tube construction cuts deflection to a minimum, smaller boiler cavities are possible. In addition, a unique method of equalizing nozzle end-thrust assures "minimum-wobble" travel regardless of distance.

IK's are just part of the reason behind Diamond's established superiority in boiler cleaning systems. Add a complete line of cleaning equipment, an experienced, imaginative engineering staff and an unmatched service organization. No wonder thousands of utility and industrial power plants are equipped with Diamond Cleaning Systems — engineered and designed to provide you with more economical power.



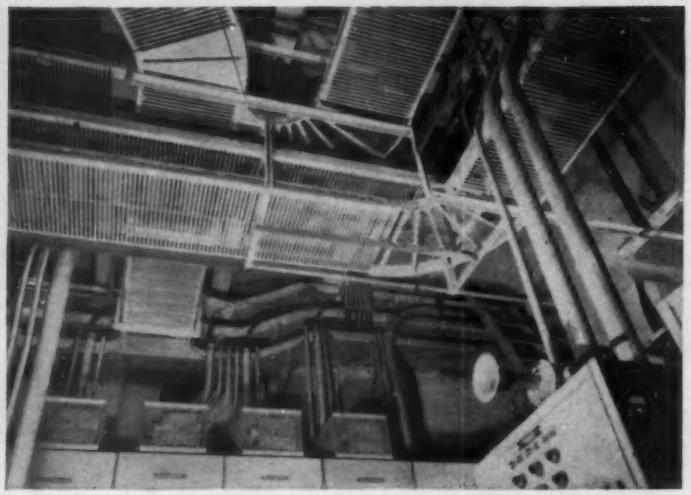


Diamond

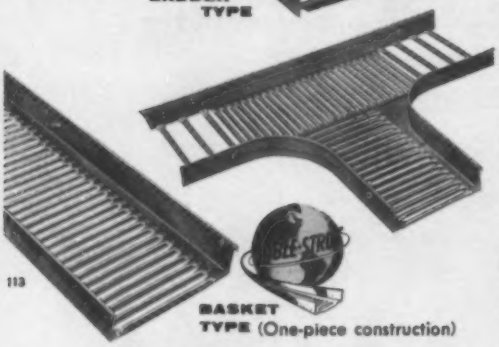
DIAMOND POWER SPECIALTY CORPORATION, Lancaster, Ohio • DIAMOND SPECIALTY LIMITED, Windsor, Ontario

how INLAND STEEL uses GLOBE INTERCHANGEABLE TRAYS to support cables in their Indiana Harbor Plant

★ Engineered for Uniform Design and Easy Installation
★ Steel or Aluminum Construction
★ Complete Accessories for SPEEDIER Installation
★ Complete Interchangeability
★ No Sharp Edges to Damage Cables



LADDER TYPE



113

BASKET TYPE (One-piece construction)

Globe's two types of cable trays, one a ladder type and the other a basket type, to support cables, wiring and tubing have become increasingly popular because they can be used INTERCHANGEABLY at any given location depending on the type and weight of the cables to be suspended. The advantages of each type tray can be used to the fullest. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is used for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants and for power distribution in all types of manufacturing processes. Send for FREE catalog giving full information and installation techniques.

PRODUCTS DIVISION
THE GLOBE COMPANY Manufacturers since 1914
4022 Princeton Ave., Chicago 9, Ill.

Representatives in all principal cities . . . consult the yellow pages in your phone book under "Conduits" for the one nearest you.

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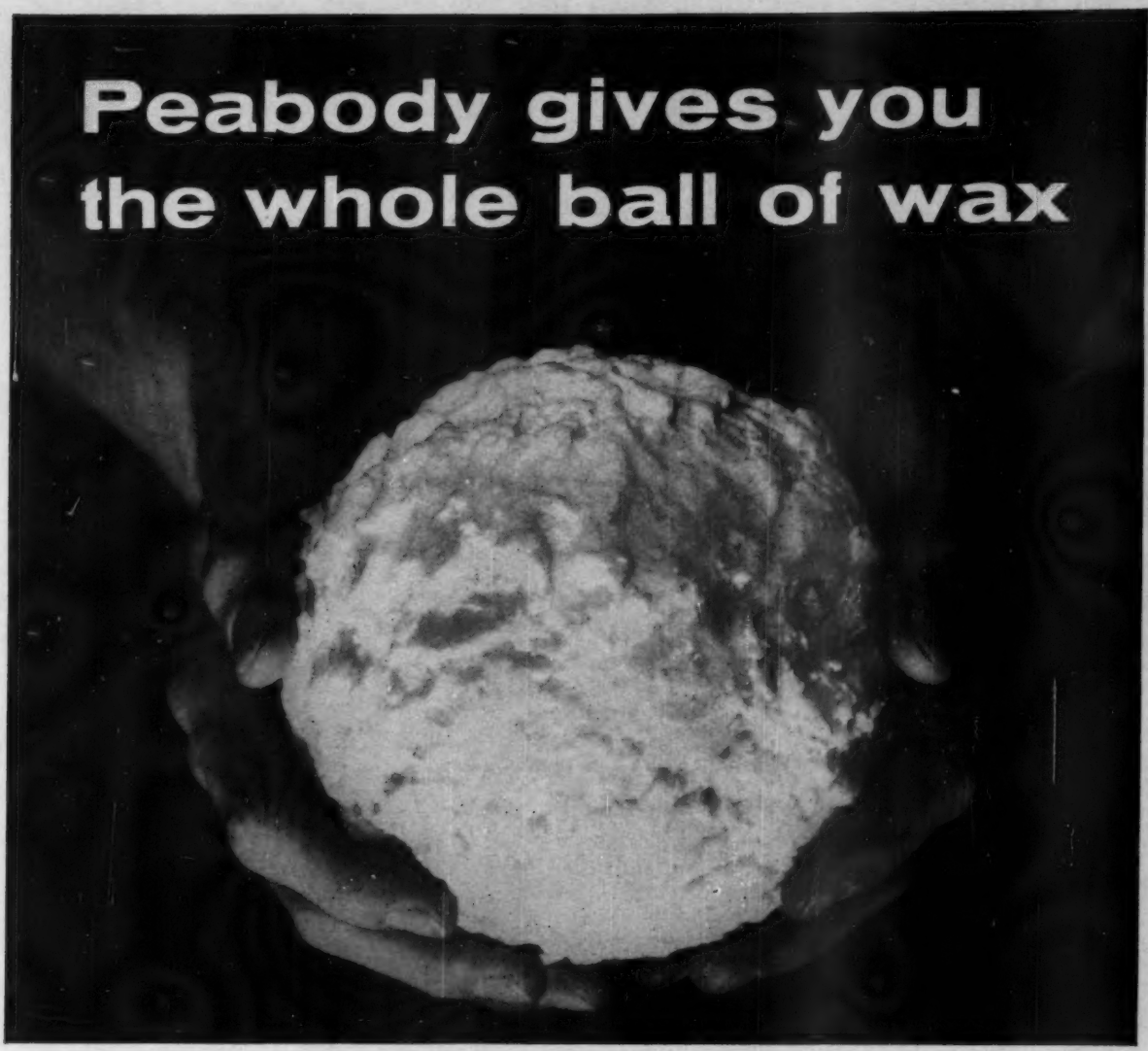
Peabody gives you the whole ball of wax



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Every step of the way, Peabody customers get individual attention. Peabody's trained combustion engineers will help you select the most efficient coal-burning equipment, or convert your present equipment to coal. They will help determine the *right* coal for your specific needs, and advise you in its most economical utilization. Your coal is mined by the most modern methods . . . then tailor-made in Peabody's automated Processing Plants under rigid laboratory control—accurately sized, washed and heat-dried. Company-owned railroads, high-capacity loading docks on the inland waterways and major trunkline railways bring you on-schedule deliveries.

Whether you buy a carload or a trainload—this complete coal service . . . *the whole ball of wax* . . . is yours simply by calling your nearest Peabody office.

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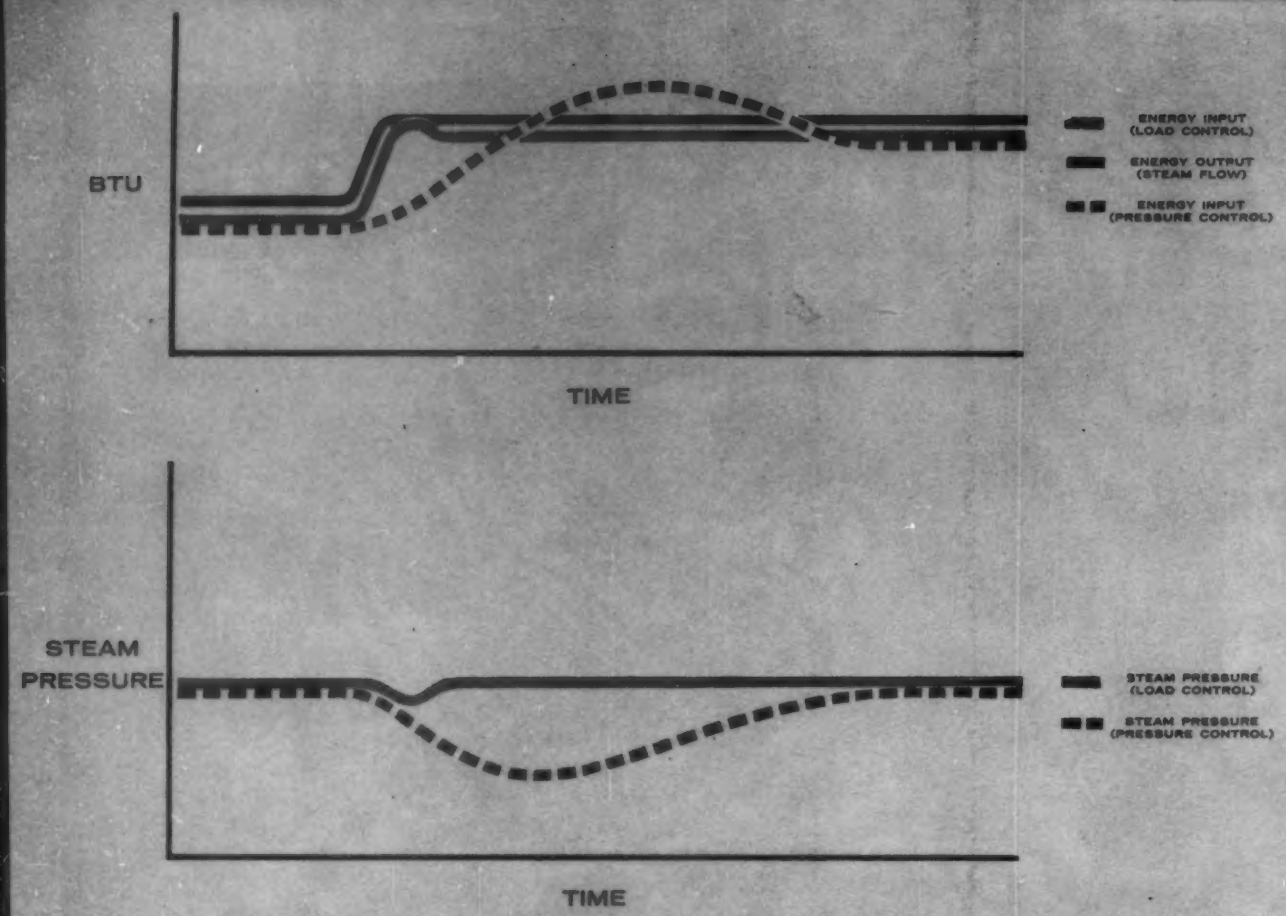


Republic's patented electronic load control system quickly establishes new firing condition and rate of feedwater flow. Note that steam pressure varies a relatively small amount and for a short interval. Electronic load control establishes new energy levels much faster than steam pressure control systems. This high speed control results in improved stability and safety. Steam pressure is more accurately controlled, and a more efficient fuel-air ratio is maintained.

Republic Electronic Load Control Gives

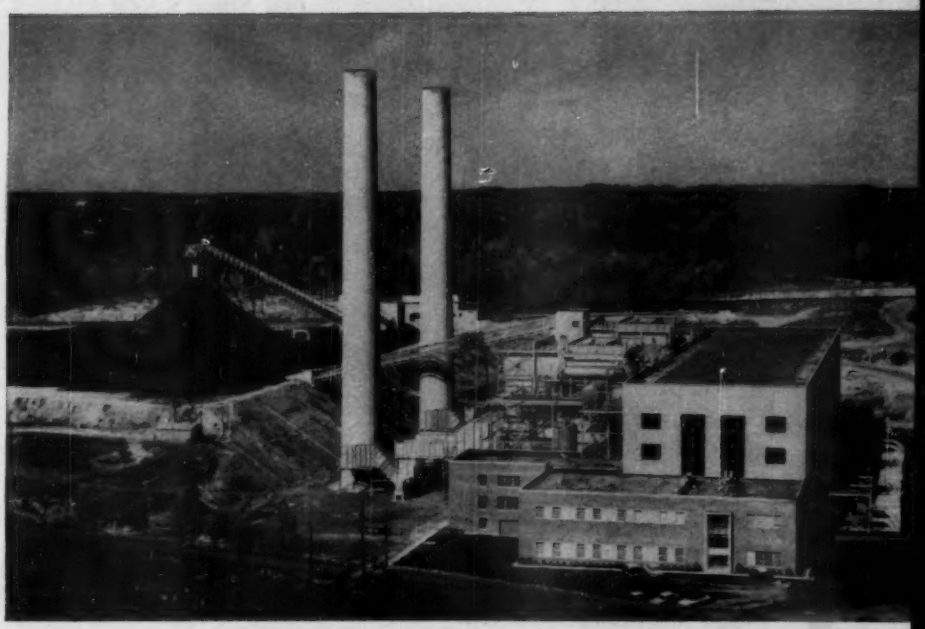
Republic patented electronic load control instantly proportions fuel flow, air flow, and feedwater flow to a precise measurement of unit load. The moment a turbine steam inlet valve setting changes, Republic's load control changes the firing rate—long before steam pressure can vary. Minor pressure variations due to inaccuracy of fuel measurement impose a final adjustment to return steam pressure to the set point. Correct steam pressure is quickly restored because these small deviations from set point require proportionately short intervals for correction. Pressure swings are practically eliminated.

Accurate Control of Fuel-Air Ratio. Electronic load control makes it practical to control air flow directly from energy output or total steam flow. Fuel flow changes immediately with a change in steam flow, and only final trimming of fuel from steam pressure is required. The time interval between air flow change and fuel flow change is insignificant. Thus, with fuel flow and air flow changing simultaneously, air flow is proportioned directly to steam flow, and safe, accurate control of fuel-air ratio is maintained.

More Stable Feedwater Control. Feedwater flow is proportioned to the master load signal from the Republic load control system. It is also modulated by the drum water level. This provides the final minor correction that maintains the drum water level at the setpoint without excessive controller action.

LOWEST BTU INPUT PER KWH

Silas C. McMeekin Station of South Carolina Electric and Gas Co., established a fine record of 9,093 BTU input per net KWH output, according to the latest Federal Power Commission Report. Equipped with a Republic electronic combustion and load control system (central control room shown above), the new McMeekin station (right) has a capacity of 250 MW with its two 910,000 lb/hr boiler systems.



Faster Response, Greater Efficiency

Improved Steam Temperature Control. Under load control, under-firing and over-firing are greatly reduced because firing rates are quickly matched to energy output. The fuel air ratio is accurately controlled. Combustion gas flow and temperature are maintained at boiler design levels, minimizing the correction required of the steam temperature control equipment.

In Duty Since 1949. Republic pioneered electronic combustion controls with the first such system installed in Commonwealth Edison's Ridgeland Station in 1949. More than 125 Republic electronic combustion control systems have been installed totalling more than 400 unit years of operation.

Republic patented electronic load control is typical of Republic engineering leadership for over 50 years. Let a thoroughly experienced Republic sales engineer help you with your instrument and control problems. Contact your nearest Republic representative, or write Republic Flow Meters Co., 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Co., Ltd., Toronto, Subsidiary of Rockwell Manufacturing Co.

REPUBLIC INSTRUMENTS AND CONTROLS

more fine products by

ROCKWELL

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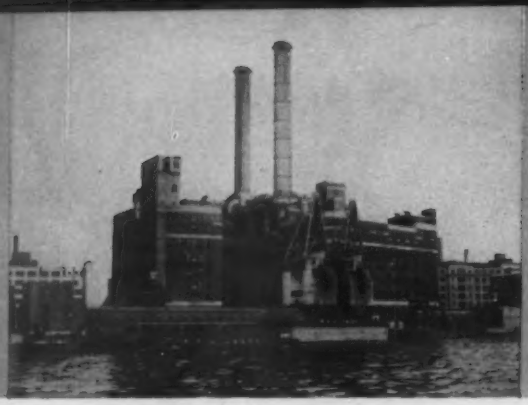
FIRST

East River Station. One of the three huge C-E boilers completed in 1929 for Consolidated Edison Company of New York was the world's first boiler to produce a million pounds of steam per hour. To mark the unit's completion, a luncheon for 90 persons was served inside its furnace.



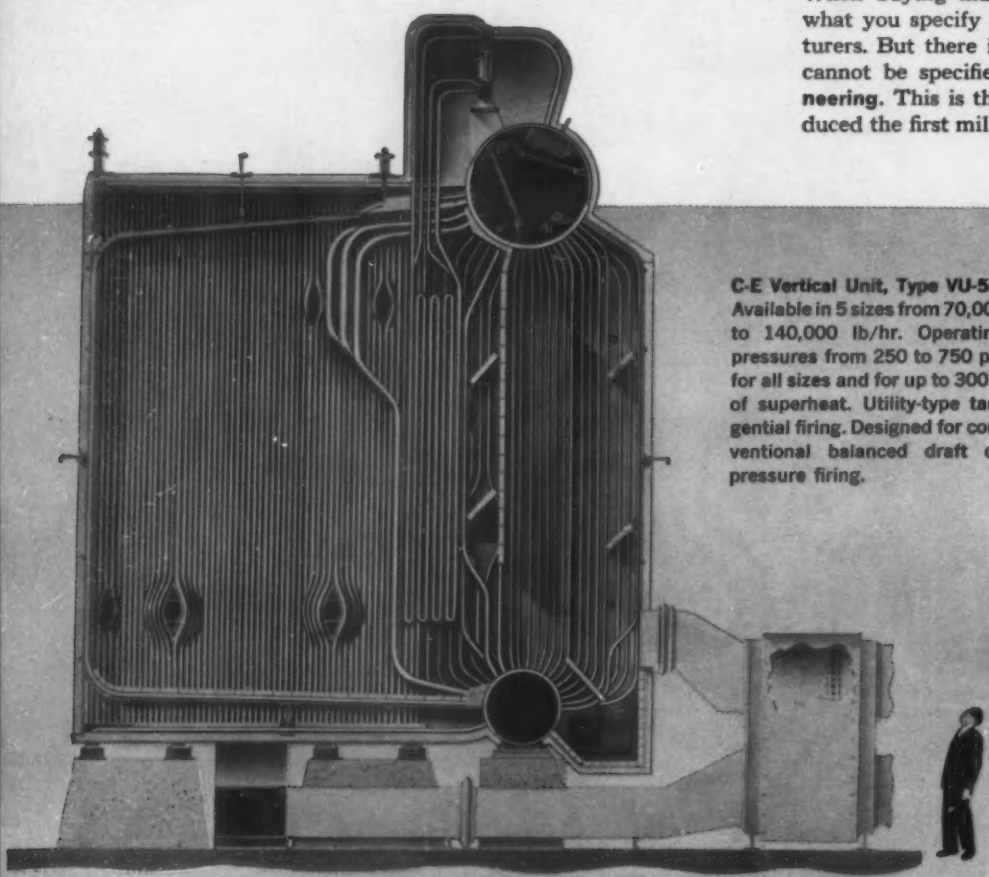
HIGHEST

Eddystone Station. World's highest-pressure utility boiler went into operation in 1959 at the Eddystone Station of Philadelphia Electric Company. This supercritical C-E unit serves a 325,000-kw turbine and is designed for an operating pressure of 5000 psi and temperature of 1200 F.

In C-E Industrial Boilers—

UTILITY-BOILER ENGINEERING

When buying industrial boilers, you can get what you specify from a number of manufacturers. But there is an intangible quality that cannot be specified: **C-E's utility-boiler engineering.** This is the engineering skill that produced the first million-pound-per-hour boiler in



C-E Vertical Unit, Type VU-55. Available in 5 sizes from 70,000 to 140,000 lb/hr. Operating pressures from 250 to 750 psi for all sizes and for up to 300 F of superheat. Utility-type tangential firing. Designed for conventional balanced draft or pressure firing.

C-E Vertical Unit, Type VU-10. Available in 9 sizes from 10,000 to 60,000 lb/hr. Operating pressures to 475 psi, superheat to 150 F in 20,000-60,000 range. Efficient over a wide range of output. Coal, oil or gas-fired.

WRITE FOR CATALOGS

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

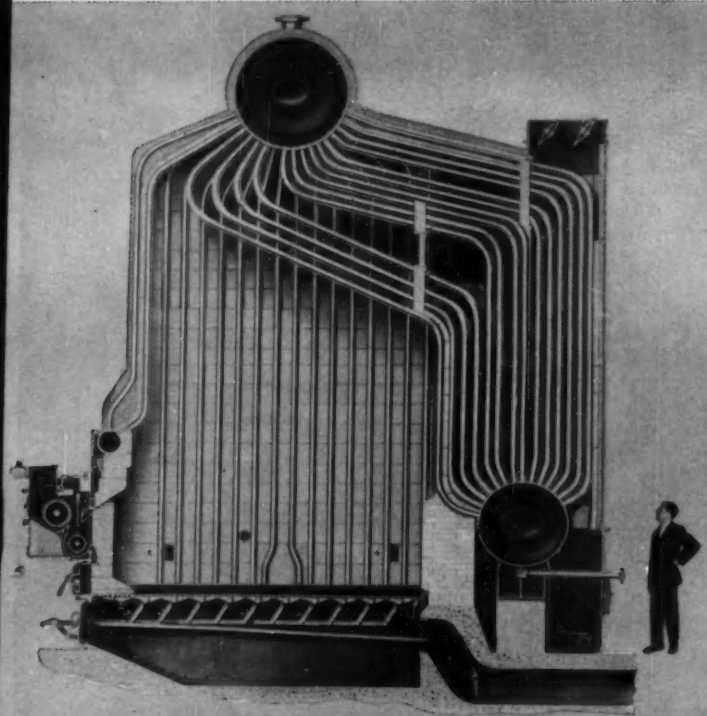
LARGEST

Will County Station. Work is in progress on an additional 510,000-kw C-E unit for the Will County Station of Commonwealth Edison Company, Chicago. The largest boiler ever ordered by an American utility company, the new 20-story structure will require over 450 carloads of material.

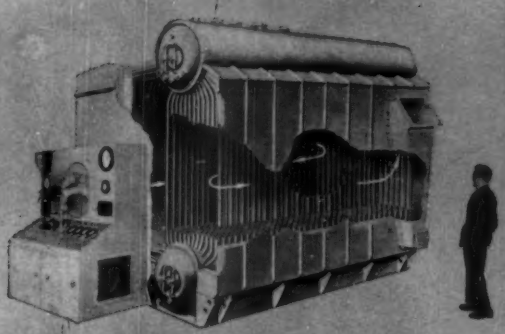
GIVES YOU EXTRA QUALITY

1929, the world's highest-pressure utility boiler in 1959, and is now at work on the largest boiler ever ordered by an American utility company.

Because C-E engineers are accustomed to the uncompromisingly high standards of the electric utilities, you can expect many extras when C-E builds an industrial boiler. These show up as refinements in design, uniformly high-quality materials, superior manufacturing techniques. For catalogs or other information, contact C-E headquarters or your nearby branch of C-E's nationwide sales and service organization.



C-E Package Boiler, Type VP. Available in two types and in a wide range of sizes from 4,000 to 90,000 lb/hr. Operating pressures to 700 psi, temperatures to 750 F. Reinforced, gas-tight, welded-steel casing. Ready to install on simple concrete foundation.



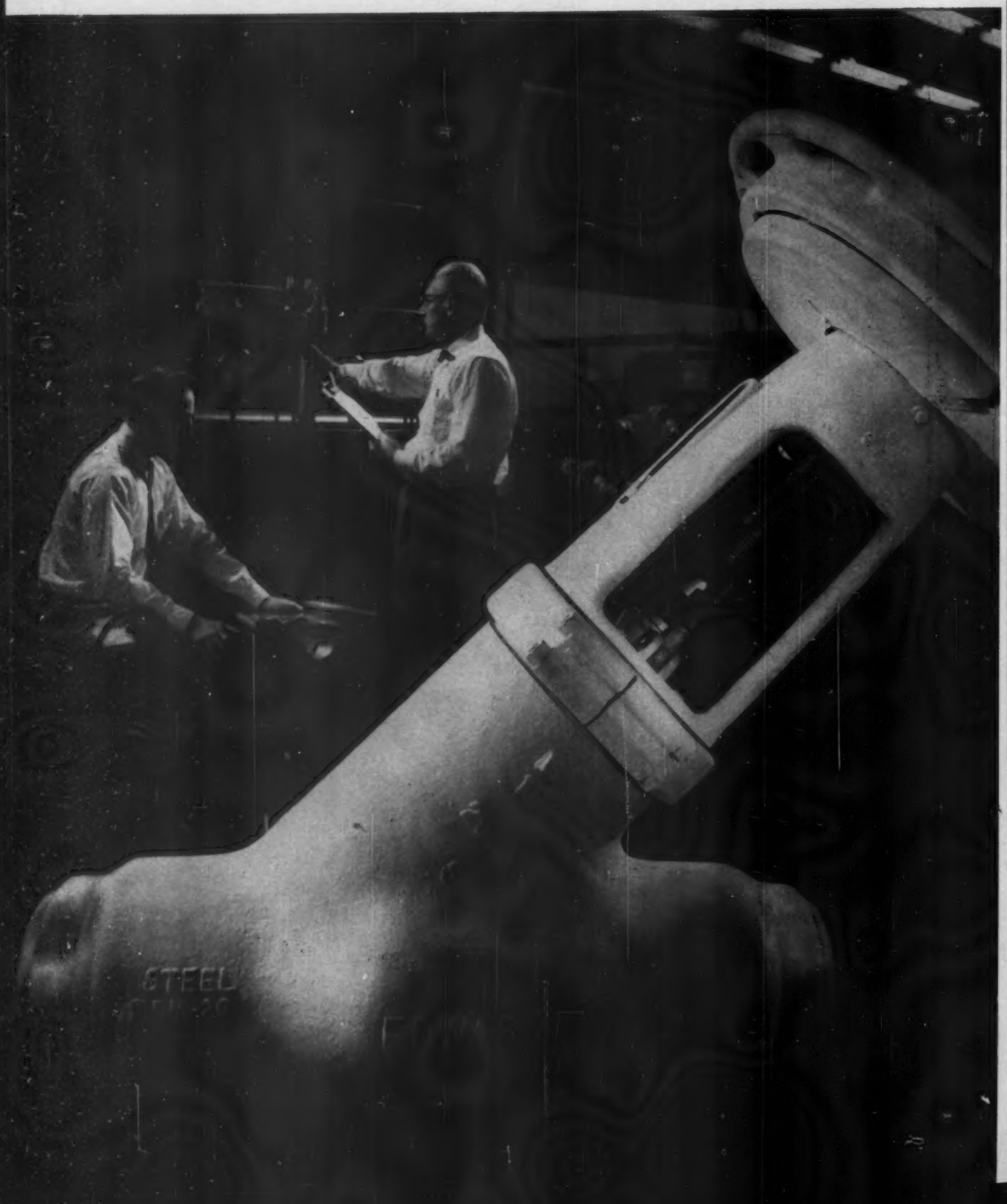
COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.

C-282

How Edward Valve Research



Reduced Pressure Drop 70%

Power industry advances in unit size created a need for large, high pressure steel valves (ten inch size and larger, 1500 lb class and higher) with three basic qualities: 1. Permanent tight seating; 2. Capacity to handle high flow rates being encountered in new, high pressure plants; 3. Reduced downtime through simplified maintenance. Edward researchers developed the Flite-Flow* design to satisfy that need. This is their story.

In 1951 Edward had already developed large cast steel globe valves with excellent dependability and repairability. Long experience in building inclined stem Y-type valves in small sizes indicated that this configuration offered a more efficient flow path. Edward research engineers set out to learn whether sufficiently strong pressure containing structures might be built in the Y-type design in larger sizes. They also sought to find out if pressure drop could be reduced sufficiently to make such a valve practical for high pressure power plant services.

The project consisted of three steps:

1. INTERNAL CONTOUR DESIGN—Flow tests were conducted with a series of plastic models. Early in the testing program it was observed that flow capacity was not always directly related to the size of the opening. Reduction of turbulence proved to be even more important. This eventually led to subtle internal contour changes to pre-shape the flow before passing through the valve seat. More material was added to certain internal areas to gain additional structural strength.

2. DISK GUIDING TESTS—To compensate for the angular position of the stem-disk assembly tests were conducted to determine whether conventional three-point guiding used in vertical stem Edward valves would be adequate for the inclined stem design. Experiments suggested that four equally spaced guiding surfaces would be superior. This is important in floating disk types such as check or stop-check valves where disk-piston assembly must seat automatically.

*T.M. Reg. U.S. Pat. Off.

3. STRUCTURAL STRENGTH—The usual weakness of a Y-type pressure containing vessel received much attention. Optimum valve contour as determined by flow testing permitted use of a structural member in the flow passage at the downstream side of the seat port. This structural member provides strength exactly where needed without significant increase in pressure drop. Introduction of this segment to the valve body casting without sacrifice in pressure drop was a significant achievement.

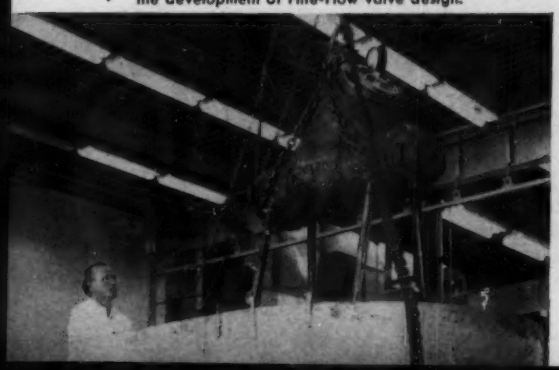
RESULTS: This program covered a period of six years. Tests of the completed design were most gratifying. Structural stability, a major problem, was excellent. Strain gage and brittle lacquer tests of finished valve bodies showed stresses well within acceptable limits. Pressure drop reduction amounted to as much as 70 per cent from best previous globe valve experience. Extended tests of finished product at pressures and temperatures above rating showed no operating weaknesses. The Flite-Flow is truly a dependable, repairable, low pressure drop valve.

Edward builds a complete line of forged and cast steel valves from ¼" to 24" for industrial, marine, petroleum and technological services. For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1202 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal.

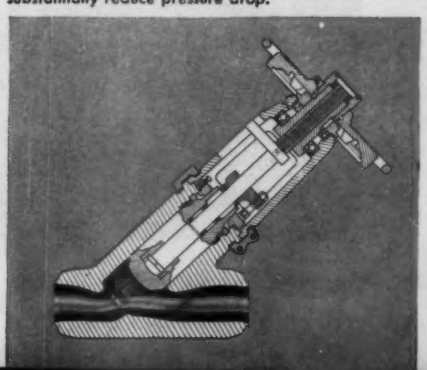
EDWARD STEEL VALVES
another fine product by
ROCKWELL

◀ **W. G. Lunt, research engineer, and E. B. Pool, chief research engineer, study flow phenomena in plastic half-model of tentative Flite-Flow design.**

▼ **Edward research team lowers experimental valve into test furnace where it is subjected to prolonged extremes of heat and pressure. This was one of the final steps in the development of Flite-Flow valve design.**

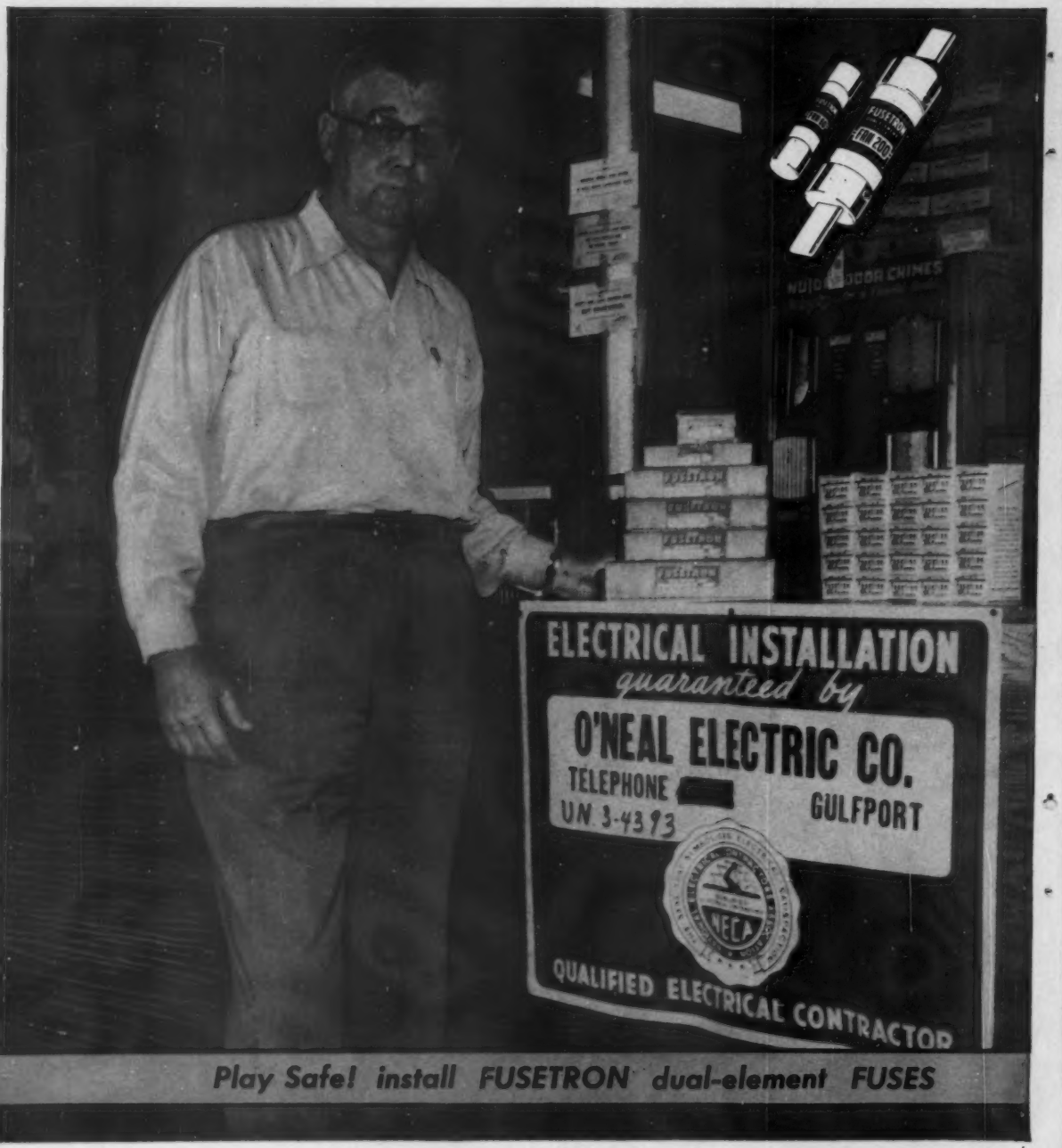


Cutaway view of Flite-Flow valve showing how inclined stem Y-type valve configuration has been adapted to larger size units for power plant services. This internal contour design enabled Edward research engineers to substantially reduce pressure drop.



"We helped a customer stop frequent outages and get safe motor protection . . . by recommending FUSETRON Fuses"

OSCAR O'NEAL SR., PRES.
O'NEAL ELECTRIC CO., GULFPORT, MISS.



Play Safe! install FUSETRON dual-element FUSES

Mr. O'Neal continues . . .

"Sometime ago, the Gulfport Ice Co., called us in to do their electrical maintenance work. At the time, they were having a great deal of difficulty with motor starting currents causing ordinary fuses to blow. They were using 100, 200 and 400 amp. ordinary fuses to protect the motors.

"These frequent outages disrupted the company's normal operation and created a costly and annoying situation. Just to replace the 400 amp., 250 volt ordinary fuses was costing them about $40 a month.

"My first recommendation to them was to change to Fusetron dual-element fuses in the proper size for safe motor protection. They did.

"The installation of Fusetron fuses was the 'key' to the problem. In the past five years I do not recall one 400 amp. Fusetron fuse having blown — and outages on the 100 and 200 amp. circuits have been very infrequent."

YOU TOO, CAN GUARD AGAINST UNNECESSARY OUTAGES OR MOTOR BURNOUTS THAT CAUSE MEN AND MACHINERY TO STAND IDLE SIMPLY BY INSTALLING FUSETRON DUAL-ELEMENT FUSES THROUGHOUT THE ENTIRE ELECTRICAL SYSTEM.

In addition to saving you money by protecting against needless outages and motor burnouts

FUSETRON Fuses offer High Interrupting Capacity and Life-Time Dependability Essential to Modern Protection.

High Interrupting Capacity: With electrical network capacities steadily increasing, — a *modern* protective device must be capable of interrupting the heavy fault currents now available and to be adequately safe to allow for anticipated growth in service demands.

FUSETRON fuses give you this protection. They have an exceptionally high interrupting rating of 100,000 amperes rms symmetrical.

Life-Time Dependability: The increase in available fault currents has emphasized the need for dependability in modern protective devices, otherwise, serious fire and personal injury can result should the device fail to operate when an emergency arises.

FUSETRON fuses provide safe and accurate protection through the years as their operation depends on a simple thermal law. Unlike mechanically operated devices, Fusetron fuses have no hinges, pivots, latches or contacts to stick or get out of order.

Once properly installed, Fusetron fuses require no maintenance, — no periodic inspection and accompanying down-time.

If you are considering a new installation or the modernization of an electrical system — you can be sure of modern, safe, maintenance-free protection in 10 or 20 years by installing Fusetron dual-element fuses now.

For more information on FUSETRON dual-element fuses . . . Write for bulletin FIS.

BUSSMANN MFG. DIVISION
McGraw-Edison Co.
St. Louis 7, Mo.

210

throughout entire Electrical System!

FUSETRON — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — BUSS — McGRAW EDISON

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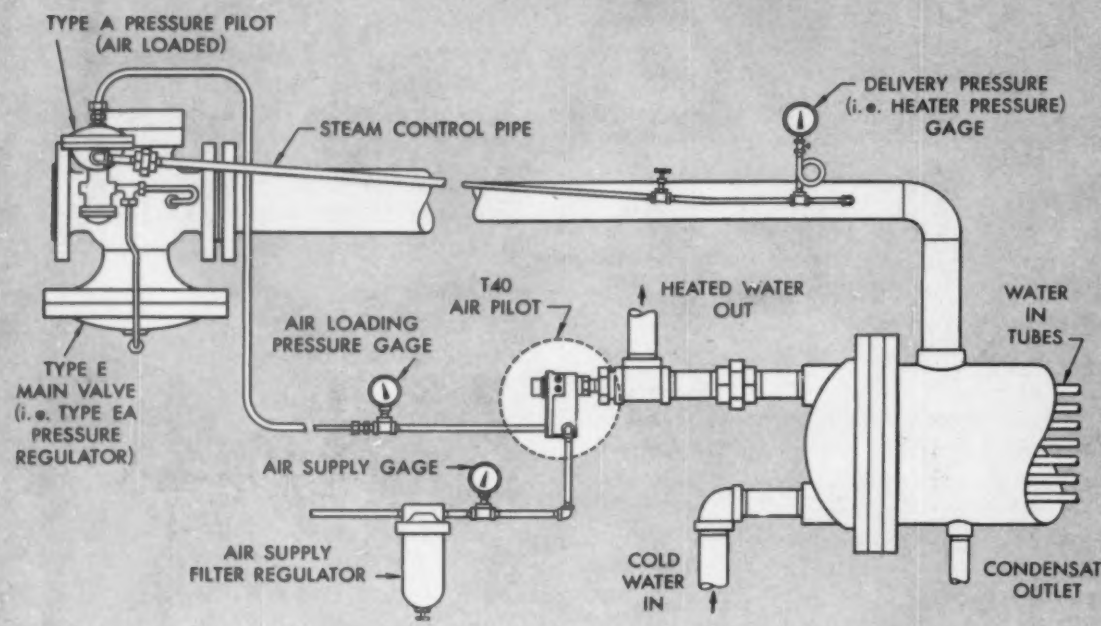
New Spence Temperature Control System Gives Unusual Control Accuracy


TYPE A PRESSURE PILOT (AIR LOADED)
STEAM CONTROL PIPE
DELIVERY PRESSURE (i.e. HEATER PRESSURE) GAGE
T40 AIR PILOT
HEATED WATER OUT
WATER IN TUBES
AIR LOADING PRESSURE GAGE
TYPE E MAIN VALVE (i.e. TYPE EA PRESSURE REGULATOR)
AIR SUPPLY GAGE
AIR SUPPLY FILTER REGULATOR
COLD WATER IN
CONDENSATE OUTLET

TYPE EAT40 AIR-CONTROL TEMPERATURE REGULATOR (Patent Pending)

In a recent installation the new Spence air-control temperature regulating system provided:

- ±5°F control accuracy under wide and instantaneous load swings of 210 to 80 gallons per minute.
- Up to 50% reduction in cost as compared to instrument systems of similar accuracy.

This unique cascade-type control with throttling range adjustment independent of maximum heater pressure was developed to meet today's demand for greater control accuracy.

Additional features of the new Spence Temperature Control System include:

- 200°F wide adjustable temperature range
- Adjustable speed of steam pressure change
- Over and under temperature protection
- Pressure limit control
- Fast response
- Very low air consumption
- Field reversible for heating or cooling

The Spence Type EAT Air Control Temperature System, when properly installed, will tame wide ranging, fast changing loads of instantaneous heaters and modern heat exchangers. The cascade principle plus the use of an extremely fast responding bi-metal temperature sensing element reduce time lags and provide control stability.

Here's how the new Spence system operates:

Quick response is based on a bi-metal temperature sensing element. Temperature pilot continuously regulates a loading air pressure.

This loading signal, when applied to a pressure regulator to reflect heater temperatures, causes it to adjust the main valve as changes in load require.

Spence has also developed a new pressure control system based on this same cascade principle. This system has a control accuracy of ½ psi or better from positive pressures through the vacuum range to 30" Hg.

For complete information on these new air controlled temperature and pressure control systems, write for your copy of Bulletin 9.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York 55-140

For more data circle 515 on Post Card

U. P. GENERATING COMPANY FOUND A WAY TO BE SURE OF CHOOSING THE RIGHT TURBINE OIL

They selected NONPAREIL —the only oil with life-of-turbine guarantee

Situation: In 1955, Upper Peninsula Generating Company installed a 22,000 kw General Electric turbine in its Presque Isle station. When lubricant for this turbine was chosen, U. P. management elected to install an oil with a life-of-turbine guarantee—NONPAREIL.

But that wasn't all plant management received when the decision was made to buy NONPAREIL Turbine Oil. In addition, Duane Johnson, Standard Oil lubrication specialist located in Marquette, made a complete lubrication survey of the entire plant. He provided technical service on lubrication during construction and after operations started.

What has happened: In the four years since installation, the turbine has performed satisfactorily without any lubrication difficulty. In a routine inspection a year after installation, the bearings proved to be in excellent condition. Periodically samples of the oil have been removed for analysis at Standard Oil's Whiting laboratory. The oil remains in its original excellent condition.

What you can do: Get this life-of-turbine guarantee on the turbine oil you install by specifying NONPAREIL. Call the lubrication specialist in the Standard Oil office near you anywhere in the 15 Midwest or Rocky Mountain states. Or contact **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from STANDARD *and you get it!*

Standard Oil lubrication specialist Duane Johnson (left) and station chief engineer Charles York, inspect 22,000 kw G-E turbine at Presque Isle station. On lubrication jobs of this kind Duane Johnson is well qualified to provide technical service. He has an engineering degree from the Michigan College of Mining and Technology plus 10 years' experience with Standard in this work. He has also completed Standard's Sales Engineering School.

Quick facts about
NONPAREIL
TURBINE OIL

- Will not permit formation of harmful acids
- Will not permit formation of sludge or oil varnish
- Will maintain good demulsibility or water-separating characteristics
- Has high resistance to foaming
- Contains adequate rust inhibitor

Vogt PACKAGED

FORGED STEEL FITTINGS, FLANGES and UNIONS

Complete product identification and data on label attached to carton.

Vogt modular designed cartons give added handling and storage space economies. All dimensions are in multiples of 3 inches.

for **MATERIAL HANDLING ECONOMY**

1 Easy Inventory Identification

2 Easy Handling

3 Protection Against Damage

Handling and inventory costs are held to a minimum with Vogt modular packaged forged steel fittings, flanges, and unions. The small cartons, of restricted weight, are appreciated by the distributor and user alike for their easy handling and the protection given the products against damage.

The label attached to each carton completely describes and pictures the product and gives the quantity, size, end type, pressure, and catalog number.

Write for Folder PF-1 for complete data on quantities and weights of the items as packaged in various sizes of cartons.

Address Dept. 24A-FPE

HENRY VOGT MACHINE CO.
P.O. Box 1918 Louisville 1, Ky.

SALES OFFICES New York, Chicago, Cleveland, Dallas, Camden, N.J., St. Louis, Charleston, W.Va., Cincinnati

For more data circle 530 on Post Card

Current Catalogs

Fans and Blowers

101 Propeller Fans — Included in 20-pp Bulletin A-109 E of Hartzell Propeller Fan Co. is new line of low-speed high volume fans designed to increase efficiency and economy where large volumes of air must be moved, because a single unit does the work of several smaller ones. The line covers sizes from 65 to 94 in., in belt-, direct- or pulley drive. Other fans cataloged are ring and panel mounted types from 12 to 60 in., low noise and high pressure models, a reversible fan, and pedestal and spot cooling types.

102 Tubeaxial Fans — Bulletin 625, 8 pp, describes construction features of Robbins & Myer's, Inc., Type BT and BTV belt-driven tubeaxial fans, 30-60 in., 3-50 hp with air deliveries to 85,000 CFM, and gives details on various polluted and high temperature atmospheres they are designed to handle. It also includes data on ventilating system designs with emphasis on hood design and open surface tank ventilation. Photos, tables included.

103 Standard Blowers — Featured in Airfan Engineering Co.'s 26-pp Catalog STD-60 is a line of standard blowers, including four-way discharge, twin assemblies, triple assemblies, utility sets, and cabinet blowers. Includes capacity tables, dimensional data and specifications.

104 For Industrial Ventilating — Illustrated and described in this product bulletin released by Hartzell Propeller Fan Co. is industrial ventilating equipment for use in corrosive atmospheres. Includes performance data as well as information on special corrosion-resistant materials and coatings for ventilating equipment.

Pumps, Compressors

105 Simplified Pump Selection — Technical data is simplified and presented in an easily-understood way in the Deming Co.'s rotary pump selection manual. Groups liquids according to viscosity and each classification has its own selection table. Fast selection is possible by matching liquid to pump. Selection tables cover most all liquids.

106 Rotary Gear Pumps — Features and advantages of the Gearex Pump which employs the basic rotary gear principle to move liquid are detailed by Sier-Bath Gear and Pump Co., Inc. in 6-pp Bulletin G-3. Cutaway view illustrates construction details.

107 Rotary Vacuum Pumps — Features of Consolidated Vacuum Corp's oil sealed rotary vacuum pumps are detailed in 6-pp Bulletin 8-15. Discusses building block construction, ease of maintenance of these pumps, includes selection suggestions. Dimensions, physical specifications and data on speeds and capacities provided for single- and two-stage models.

108 Rotary Air Pumps — Catalog 460, 32 pp, of Leiman Bros., Inc., describes rotary positive air pressure and high vacuum pumps, gas boosters and air motors. Gives construction details, dimensions, capacities, performance curves for all pumps, plus comprehensive engineering and application data. Included are two- and four-vane types, single and double cylinder, fan-cooled, water-cooled, air-cooled, oilless, motor-driven, belt-driven, direct-coupled, automatically controlled and integral pump and motor models.

109 Sizing Cooling Tower Pumps — Six steps to be taken in sizing pump and piping of any cooling tower installation are explained in 6-pp Bulletin CT-360 by Bell & Gossett Co. Provides selection charts, pipe sizing tables and drawings of typical cooling tower installations.

110 Pumps, Proportioners — Eight-pp Bulletin 600 describes Vari-Flow variable capacity rotary pumps of Blackmer Pump Co. These pumps are designed to let you "dial" desired flow rate, from zero to full capacity without changing pump speed. Explains principle of operation and includes cutaway illustrations of four basic models offered in ball-bearing or packing-gland types, sizes to 450 gpm.

111 Centrifugal Air Compressor — Twenty-pp Bulletin 175 introduces the IsoTemp package centrifugal air compressor line for air separation plants and industrial use manufactured by Clark Bros. Co. In addition to detailed engineering data, brochure incorporates illustrations and descriptions of design features.

Packings, Seals

112 Cup Packings — Properties and characteristics of Rex-Syn cup packings — a combination of a plastic resin and elastomer — are described in a recent E. F. Houghton & Co. bulletin. Gives standard sizes for Rex-Syn and outlines results of several field tests.

113 Molded Packing — Engineering Bulletin K-260, Greene, Tweed & Co., presents technical information on Palmetto Kups, single lip piston seals for hydraulic or pneumatic applications wherever there is reciprocating motion. Provides specifications and application data, gives recommended uses. A table lists fabric and synthetic composition Kups offered, and covers their temperature ranges (to 600 F) and services.

114 Mechanical Seals — Eight-pp Bulletin AD-150 of Garlock Inc. describes engineering and application of Mechanipak ready-to-install seals. Illustrated with sectional drawings, bulletin outlines temperature, pressure, shaft speed and other critical operating information and includes handy selection tables.

Valves, Piping, Fittings

116 Electric Check Valve — Described in 8-pp Bulletin W-10A of Golden-Anderson Valve Specialty Co. is a double-cushioned electric check valve which provides normal function with adjustable opening and closing speeds and fast emergency closing. Dimensional data, cross-sectional views and suggested wiring diagram are included.

117 Control Valves — Engineering and specification information on P-K Paul control valves of General Kinetics Corp.'s Venturi-ball design for all types of control and positioning equipment is presented in 16-pp Bulletin GV 101. Covers cast, bar-stock and special valves and includes illustrations and diagrams.

118 Solder Joint Valves — This Walworth Co's. circular lists in detail the size and dimensions of bronze gate, globe and check solder joint valves including the new No. 2 SJ gate valve. Each type is illustrated with a cutaway picture showing path of fluids through valve body. An illustrated set of instructions shows how to make a sound solder joint.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 119 and 120.

119 Check Valves — Bulletin WS-1A describes Golden-Anderson Valve Specialty Co's. double cushioned check valves designed to prevent hammer and shock due to back surge. Gives dimensions for these valves intended for use on boiler feed lines, steam pumps, compressors, and reciprocating pumps, for handling water, gas, oil, other fluids.

121 Relief Valves — Bulletin V-100/60, 24-pp, describes J. E. Lonergan Co's. line of bellows valves for vapor service. It gives complete details and specifications on sizes, capacities, materials and other pertinent data. The seven exclusive features of this valve are also listed.

122 Safety-Relief Valves — Liquid relief and special service safety-relief valves, including a new, low cost compact series, are presented by Farris Engineering Corp. in 28-pp Catalog FE-138. Valves shown include types for hydraulic pressure systems, liquified gases, chemical corrosive service and general industrial service. Sizing information, capacity tables, weights and dimensions, and application data are arranged in a new format which simplifies valve selection.

123 Welded Steel Pipe — Bulletin 509, 18-pp, illustrates uses of Spang CW steel pipe ranging from heating, plumbing, and sprinkler systems to snow melting, and scaffolding. This National Supply Co. bulletin illustrates applications and Spang continuous weld process and tests. Specification tables for three weights of ⅛-in. to 12-in. pipe and couplings in black and galvanized are included.

124 Steel Welding Fittings — How Husky welding fittings for schedule 40 piping are seven ways better is explained in 8-pp Catalog H-2 of Nibco, Inc. Illustrated with photos and dimensional sketches, gives data on concentric and eccentric reducers, elbows, straight and reducing tees. Also provided is comparison flow chart, information on performance.

Insulation

125 Thermal Insulation — This 16-pp bulletin released by National Insulation Manufacturers Association is designed to serve as a guide to best use of thermal

insulating materials under changing conditions of modern industry. Emphasizes "economic thickness" approach to specification, which enables determining point at which insulation gives greatest financial return for its cost.

126 One-Piece Pipe Insulation — Thermal and physical characteristics of Mono-Kover one-piece pipe insulation are detailed in Baldwin-Ehret-Hill, Inc. Bulletin J-660. Gives application details as well as specifications.

127 Duct Insulation — Six-pp Brochure IN-285A presents Johns-Manville's Microlite, a lightweight, blanket-type fiber glass insulation for heating or air conditioning ducts or combination heating-cooling ducts. Shows standard application methods for all type ducts, gives thickness and density data, and lists moisture barrier materials available already attached.

Instruments and Controls

128 Telemetering Systems — Metameter telemeters for remote measurement, recording and automatic control are described in 52-pp Bulletin M1715 of The Bristol Co. Covers principles of operation, types; application to various factors including pressure, water level, temperature, flow, motion and position; and electrical quantities. Several applications in various industries and utilities are covered.

129 Process Control Systems — This 12-pp booklet of Daystrom, Inc., outlines company's industrial process control systems, covering such subjects as the benefits of a total systems approach, what is meant by a single-source responsibility, and an explanation of this company's guarantee of 99 per cent operational availability. Discusses flexibility of a typical control system, listing the control-associated functions performed.

130 Pneumatic Process Instruments — Pneumatic instruments for process industries are described in 12-pp Catalog 515 by U. S. Gauge Div., American Machine and Metals, Inc. Pressure and temperature pilots and pneumatic transmitters are featured. Pilot specifications are listed and control actions described. Optional indicating controller features are covered, including pneumatic set-point, control by-pass and valve positioner.

131 Automation and You — Sixteen-pp Bulletin GED-3908, General Electric Co., discusses the technology, equipment and economics of automation. Assesses current state of the automation art, summarizes need for and economic benefits of automation, and provides information on six key functions: process control, computing, instrumentation, numerical control of machines, sensing, and communications. Examples from utility, industrial and other installations pinpoint advantages.

132 Digital Information System — Operation of Metrotype digital information system using all solid state components is described and illustrated in 8-pp Bulletin E72-2 of Bailey Meter Co. Complete specifications are listed along with a variety of readout devices. Also included is block diagram of basic elements.

133 Alarm/Control System — Bulletin ECM 119, about 16 pp, of General Electric Co., describes a high-capacity alarm/control system providing an inexpensive method of locating faults at unattended operations and controlling on-off functions remotely. Tells how equipment can be "customized" to suit specific supervisory or control needs.

Lighting

136 Floodlighting — Bulletin GEA-7201, 10 pp, stresses value of good floodlighting, and gives application data and product information on filament, mercury vapor and fluorescent units available from General Electric Co. Photos show typical applications in recreation area, architectural and ornamental lighting, loading platforms and industrial areas. Outlines "How to get more light per dollar."

137 Lighting Specifications — Included in the 52-pp 1960 edition of the RLM Standard Specifications, published by the RLM Standards Institute, Inc., are three new specifications for 1500 ma units: D-4 fluorescent semi-direct medium high mounting, SD-3AL semi-direct aluminum and SD-3PE semi-direct porcelain enamel units. The book contains many upward revisions of existing specifications, including new high specifications for materials and new specifications for aluminum reflectors.

138 Modern Lighting Needs — "Footcandles in Modern Lighting," offered by General Electric Co., is a 20-pp revised booklet giving lighting level recommendations for seeing tasks involved in hundreds of industrial and other activities. Figures are based on findings of Illuminating Engineering Research Institute and Illuminating Engineering Society. Also discussed are other aspects of lighting to be considered regarding lighting levels.

Mechanical Power Transmission

139 Speed Variator — Eight-pp Bulletin GEA-7018 describes General Electric Co.'s adjustable speed drive which uses the Thyratron tube to convert a-c to d-c power. Illustrates and describes design components and includes dimensions.

140 Variable Speed Drives — Six-pp Folder 2874 describes Link-Belt Co.'s constant horsepower variable speed drives designed to meet capacity demands up to 50 hp and ratios to 5.5: 1. Discusses features of a twin-strand single roll chain that operates between a pair of smooth facing wheels to change the ratio and output shaft speed as the effective diameter of the wheel faces is altered.

141 More Compact Drives — Catalog 125 is a 28-pp engineering and specification guide on Hi-Cap Wedge belt drives of Fort Worth Steel & Machinery Co. Provides step-by-step instructions on drive selection, with tables of service factors, horsepowers; dimensions and weights of 182 stock and 54 made-to-order sheave sizes, with diameters from 2.65 to 71 in.; specifications of QD bushings, bores and keyways; installation instructions.

142 Worm Gear Reducers — Book 2824, 66 pp, introduces Link-Belt Co.'s fan-cooled worm gear speed reducers in 25 types and over 135 sizes, available in ratios from 5:1 to 3600:1, with torque ratings to 135,000 lb-in. and up to 150 hp. Illustrated with application photos, book lists equipment on which these reducers have application. Selection data includes rating tables arranged according to speed as compared to ratio, with reducer sizes listed on individual pages for a given rpm.

144 V-Belts and Hose — Catalog 260, 52 pp, covers Dayton Industrial Products Co.'s line of industrial V-belts, including Cog-Belt and Poly-V and fhp types, as well as sheaves and industrial hose, providing data on sizes, and prices. A section on hose covers molded braided, horizontal braided, machine-built wrapped fabric, hand-built wrapped fabric and woven jacket types. Also given are recommended hose applications in specific fields.

145 Magnetic Particle Clutches — Characteristics of magnetic particle clutches offering low-inertia fast-response for transmission of mechanical power are detailed in this 16-pp bulletin released by Lear, Inc. Curves, installation drawings and other illustrations show various clutches and their possible uses.

Tools and Welding

146 How to Bend Conduit — Illustrated Bulletin 260, on bending conduit or pipe easily and accurately, features an improved bender introduced by Lidseen of North Carolina, Inc. Subjects covered include, calculating lengths of legs, locating bend, back-to-back method, back-to-back push-through method, and offset bends.

147 Vest Pocket Welding Guide — This revised edition of "How to Get Better Welds," published by Hobart Brothers Co., contains 80 pp of arc welding information. Covers essentials for proper welding procedures, good and bad welds, welding positions, operator qualifications, welding metals and steel available for welding. Also deals with causes and cures of common welding troubles, check points for quality welding, cost saving, safety precautions. Electrodes and factors to consider when selecting them are discussed, as are welding wires and flux, power sources.

Electrical

149 Motor Selector — Eight-pp Bulletin L-1661A, Howell Electric Motors Co., lists briefly the motor and generator lines available through consolidation of Howell with three other manufacturers. Motors range from 1/40 to 300 hp, including standard types in a variety of voltages, speeds, mountings and enclosures, as well as designs for special applications.

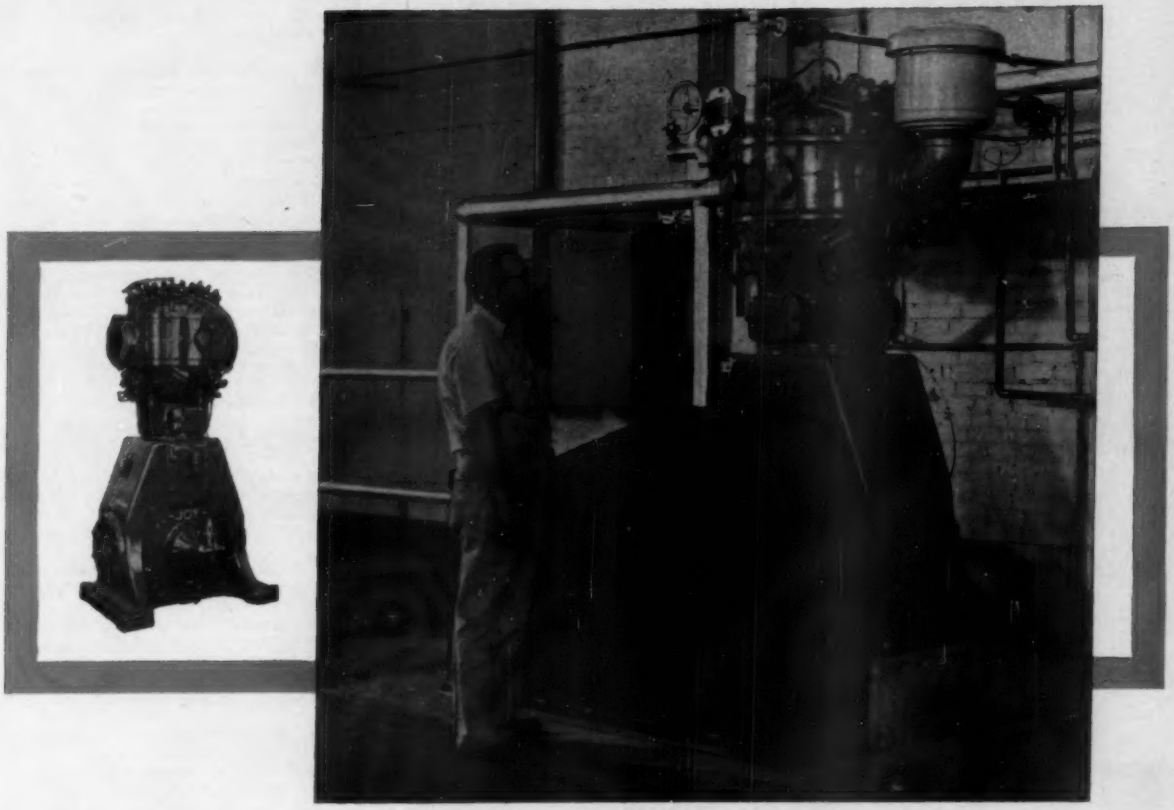
150 Shielded A-C Motors — Comprehensive 56-pp Catalog 200, Sterling Electric Motors, Inc., includes complete dimensional, selection and application data on Multi-Shielded a-c motors. Includes information for various modifications, such as specialized mountings.

151 Unit Substations — Comprehensive Workbook PSG-6001, 24-pp, aids in planning articulated unit substations for secondary distribution, and features a suggested specification form detailing data for a properly coordinated substation system. Ratings, weights and dimensions are included. Types of load centers and substations are described for indoor and outdoor use. Detailed specifications are provided by Pennsylvania Transformer Div., McGraw-Edison Co., for incoming supply sections, transformer sections and outgoing feeder assemblies.

152 New Rating Method — Eight-pp Bulletin GEA-7047, of General Electric Co., tells how new transformer rating method permits use of more kva with same operating life and same investment. Describes Permalex insulated oil-filled

Now Available Up To 150 HP

NEW JOY WG9H VERTICAL COMPRESSORS



Joy's line of highly efficient vertical type compressors has been extended to 150 hp. These new heavy duty WG9H's have the same design features which established the vertical type, single-cylinder compressor's reputation for high efficiency and low maintenance.

You can get both standard and oil-free machines in six standard atmospheric air sizes, with appropriate cylinders for gas boosting and high pressure applications, if desired. Capacity range is from 633 to 1630 cfm.

Other Joy vertical type compressors are available in a range from 15 to 75 hp. Joy also can furnish V-type and semi-radial type machines up to 1250 hp, and axial or centrifugal compressors from 15 to 15,000 hp. Whatever your air or gas compressing problems may be, Joy can supply an economical solution.

For full information on the new line of WG9H Compressors, write for Bulletin 1013-56C.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY

JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

For more data circle 517 on Post Card

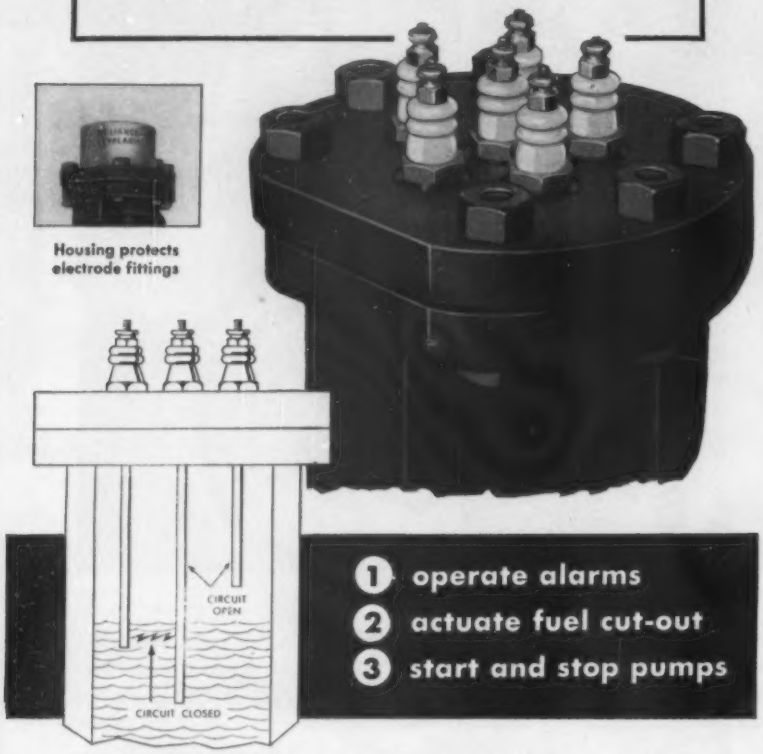
What could be simpler?

Your boiler water is a conductor;

Its rise and fall can be made to make and break circuits;

Simple efficient control to 1, 2, 3 (below)

Housing protects electrode fittings



1. operate alarms
2. actuate fuel cut-out
3. start and stop pumps

RELIANCE ELECTRODE LEVALARMS GIVE YOU *INSTANT ACTION* — at exact pre-set water levels. Minute transformer-isolated currents pass through boiler water in the column — actuate controls through relays. From one function (fuel cut-out or low water alarm) to combinations of up to *five or more* are possible with a Levalarm: low or/and high water level alarm, fuel cut-out, start and stop pumps, etc.

Electrode Levalarms are entirely electrical; they do not depend on vacuum tubes or magnets — have no stuffing boxes or bellows. Models available for every pressure or temperature.

It will pay you to get full information on Reliance Levalarms. Write the factory or contact nearest Reliance Representative.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance BOILER SAFETY DEVICES

For more data circle 518 on Post Card

distribution (5 to 500 kva) transformers and network (300 to 2500 kva) units. Discusses new 55C/65C ratings, gives data on loading and changeout practices which take advantage of higher kva.

153 Plug-In Bus Duct — Application data for plug-in bus duct is provided by Westinghouse Electric Corp. in 28-pp Application Data 30-661. Drawings, dimensions, specifications, engineering and test data included.

154 Underfloor Raceway Systems — Product illustrations and correlated information for specifying and installing Wheatland Electric Products Co.'s underfloor ducts and service fittings are presented in 12-pp Catalog 36. Includes technical specifications of the system's two sizes of ducts, regular assembly fittings and duct to conduit adapters and feeds.

155 On Bus Duct — Application data for plug-in, low-impedance, high-frequency and electric-utility bus duct is contained in 12-pp Booklet 30-660 of Westinghouse Electric Corp. General information, descriptions and drawings illustrate a variety of applications.

156 Segmented Cable — From Southern Electric Co. comes a 44-pp bulletin describing use of Compresto covered cables as weather-proof line wire, duplex, triplex and quadruplex, as well as various coverings of Neoprene, polyethylene, two coat and the high-density polyethylene. Tables of characteristics are included.

157 Cable Splicing Fundamentals — Illustrated with step-by-step photos, this 30-pp booklet of The Okonite Co. explains procedure for splicing and terminating rubber-Neoprene cables, shielded and unshielded. Also includes tape selector and quantity estimating charts, product information, purchase planning.

158 Rigid PVC Conduit — Applications of rigid polyvinyl chloride in the electrical field are detailed in this 20-pp bulletin released by Kraloy Plastic Pipe Co., Inc. Included are comprehensive test results, specfication information, installation instructions, corrosion-resistance charts, and other data.

159 Circuit Breaker Testers — Features and advantages of test units of Multi-Amp Electronic Corp. in testing low-voltage power circuit breakers and molded case circuit breakers are stressed in 16-pp Bulletin SB-CB-1. Covers typical test procedures, general considerations, selection of proper model, operation of testers, other applications. Also discusses importance of breaker maintenance, how to assure proper breaker operation.

160 Alternators, Converters — Bulletin 515-A of Robbins & Myers' Industrial Motor Div. covers design and availability of high frequency alternators and converters. Describes nine basic models of alternators from 1 to 7.5 kva and producing 360 to 3300 cycles. Also covers two types of converters in four ratings from 2.5 to 10 kw, frequencies from 120 to 420 cycles.

161 Silicon Rectifiers — Booklet B-7900, which tells why silicon rectifier packages offer d-c power saving to the electrochemical and allied industries, is offered by Westinghouse Electric Corp. This 20-pp publication presents detailed description of a silicon power package and states the advantages of silicon over other rectifying methods.

Protect steel stacks with corrosion-resistant concrete

Corrosion-resistant concrete linings, made with LUMNITE calcium-aluminate cement and suitable aggregate, will protect stacks and breechings from the corrosive action of condensate.

When expanded shale aggregate is used, these linings also provide vital insulation. This keeps stack gases hot and helps maintain better draft for greater operating efficiency. The steel shell will stay cooler, too, extending the life of exterior paint. And these monolithic concrete linings have a lower unit weight, which reduces the dead load on the supporting structure.

Whether gunited or plastered, installation is easy and economical, with concrete reaching service strength in 24 hours. For even greater convenience, manufacturers of refractories offer castables bonded with LUMNITE cement – packaged mixtures ready for use with just the addition of water.

For more information, write Universal Atlas Cement, 100 Park Avenue, New York 17, N. Y.

"USS," "Atlas" and "Lumnite" are registered trademarks L-197

INSTALLATION: Elrama Station, Duquesne Light Company, Pittsburgh, Pa.

Universal Atlas Cement
Division of
United States Steel

Offices: Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St Louis · Waco

For more data circle 519 on Post Card

FILL IN AND MAIL TO
WESTERN CHEMICAL COMPANY
Kansas City 5, Mo.
Pioneers in the chemical control of problems relating to the use of water, steam and fuel

"I have a problem..."

- ☐ scale, corrosion, or foaming in my boiler operation
- ☐ rust and corrosion in my steam and condensate return lines
- ☐ scale, corrosion, or algae growth in my cooling or condenser water system
- ☐ corrosion or scale in my potable or plant water supply lines and tanks
- ☐ rust and corrosion in my brine or sweet water system
- ☐ scaled up pumps, water jackets, compressors, coils, lines, or equipment
- ☐ sludge and moisture in my fuel oil supply
- ☐ soot deposits in my furnace combustion areas

"I'd like to know..."

. . . exactly what specific treatment your Technical Services Dept. recommends. I understand that such problems have been your specialty for over 65 years and that you have an outstanding record for restoring and maintaining efficiency of plant equipment through advanced chemical treatment. Will look forward to receiving in the near future both your latest technical literature *and* a personal letter concerning my problem. I understand that my inquiry involves no obligation.

NAME_____ TITLE_____

FIRM_____

ADDRESS_____

CITY_____

ZONE_____ STATE_____

Mail to Technical Services Dept., WESTERN CHEMICAL CO.
717 Washington St., Kansas City 5, Mo.

Other Equipment

162 Packaged Steam Generator — Design and performance features of E. Keeler Co.'s packaged steam generators for gas, oil or combination firing are detailed in 12-pp DK-1 Bulletin. Table of standard size dimensions and weights included, as well as photos of typical installations.

163 Heat Transfer Oil — Described in this bulletin is Sun 21, heat-transfer oil produced by Sun Oil Co. for use in closed circulating systems equipped with expansion tanks. High thermal efficiency and stability, easy circulation and other advantages are given.

164 Water Requirements Calculator — With this calculator available from Morton Salt Co. you can figure conversion of ppm water hardness to grains per gallon hardness, amount of exchange resin needed, brine and salt requirements for maximum efficiency, and brine tank size and operating brine level adjustments. Calculator can also be used in selecting tank size for liquid volume problems.

165 Why Coil Freeze-Ups — Technical Bulletin T-503 of Sarco Co., Inc. explains why non-freeze air heating coils freeze. This bulletin discusses the factors leading to freeze-ups, provides a chart for determining the freezing danger point, and offers some practical hook-ups to overcome freezing conditions.

166 Single Roll Crusher — Eight-pp Bulletin 2020, Pennsylvania Crusher Div., of Bath Iron Works Corp., describes a single roll crusher for heavy duty primary or secondary crushing of cement rock, gypsum, mine refuse, coal with rock in it, muddy materials, limestone, ores, shale, etc. Describes features, operation and applications, and gives dimensions.

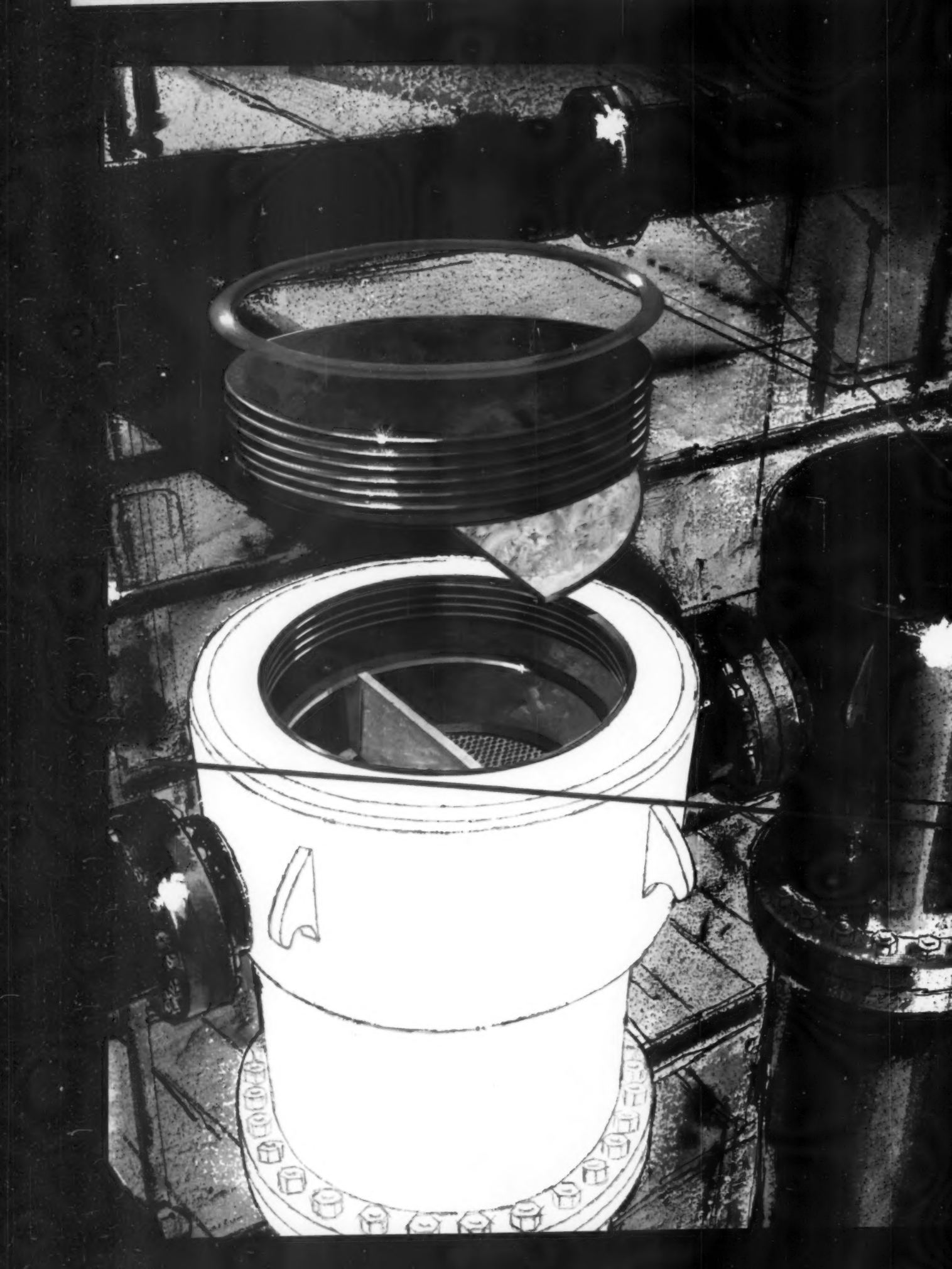
167 For Sludge Collection — Sludge collectors for normal and heavy-duty application are cataloged by Yeomans Bros. Co. in Bulletin 6751. Of practical value to power engineers concerned with sewage treatment plants or industrial waste installations, bulletin provides section drawings of typical layouts for primary and final settling tanks. Technical specifications are detailed. Also covered are modifications required to convert these units into cross collectors for multiple tanks, and to mechanical skimmers.

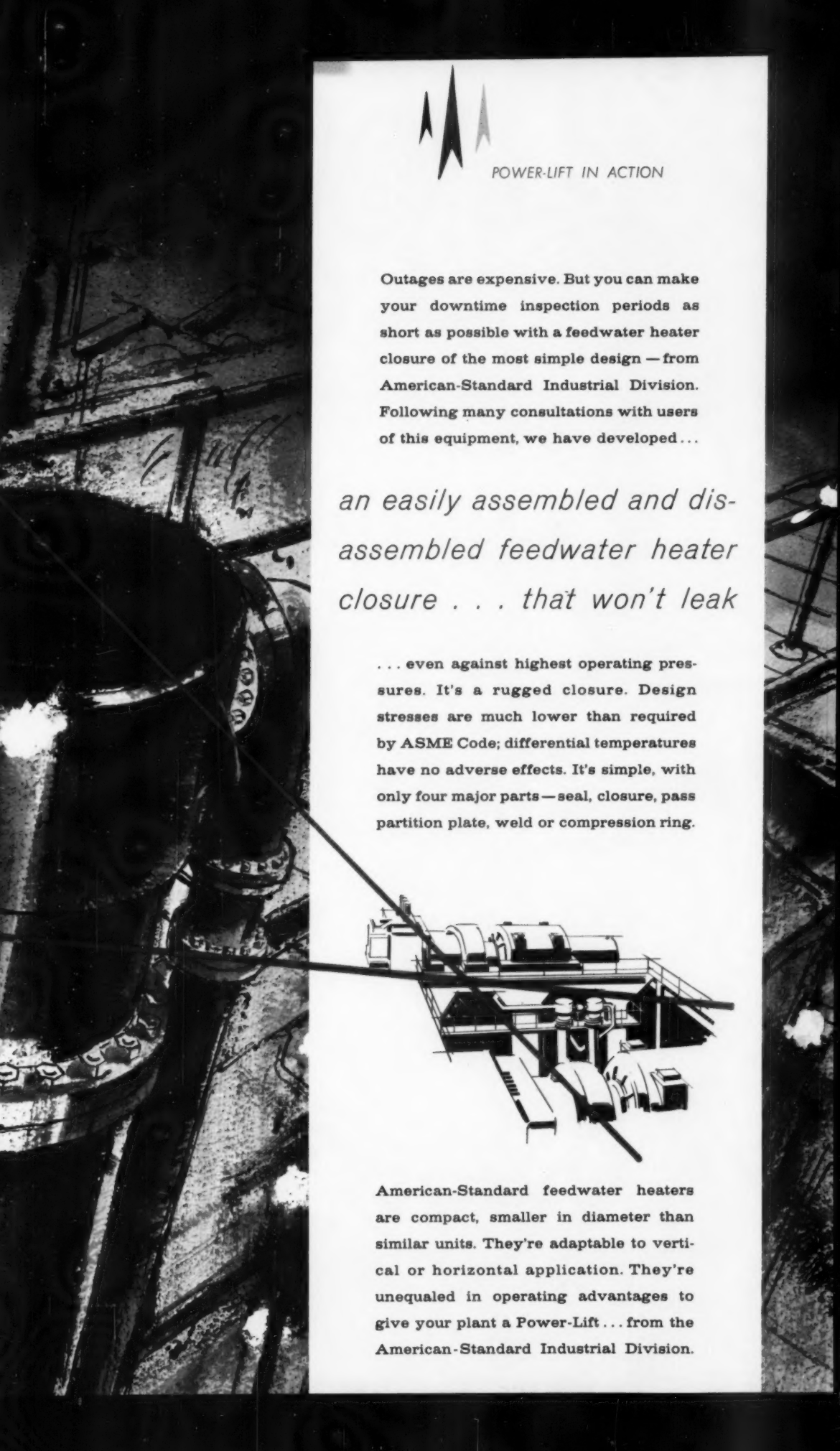
168 Vibration Control Specs — Bulletin F2D, of The Korfund Co., Inc., is a 6-pp guide to writing vibration and noise control specifications for air conditioning and related equipment. Discusses factors involved in selecting resilient mountings available, with attention to effects of existing job conditions. Photos show type of mounting to use for each problem.

169 Industrial Cleaners — This 8-pp brochure gives features and application suggestions for industrial cleaning compounds and solvents of Brulin & Co., Inc. Includes steam charge and steam cleaning compounds, degreasing concentrates, rust and scale solvents, aluminum cleaners, solvent degreasers, cold cleaners, carbon removers and paint strippers.

171 Industrial Hose — This 30-pp industrial hose catalog details manufacturing facilities and industrial hose available from Swan Rubber Co. Air, water, poly-purpose, agricultural spray, welding, paint spray, booster and other hose are described with pertinent information on applications, cover, reinforcement, tube, lengths.

For more data circle 520 on Post Card





POWER-LIFT IN ACTION

Outages are expensive. But you can make your downtime inspection periods as short as possible with a feedwater heater closure of the most simple design — from American-Standard Industrial Division. Following many consultations with users of this equipment, we have developed...

an easily assembled and disassembled feedwater heater closure . . . that won't leak

. . . even against highest operating pressures. It's a rugged closure. Design stresses are much lower than required by ASME Code; differential temperatures have no adverse effects. It's simple, with only four major parts — seal, closure, pass partition plate, weld or compression ring.

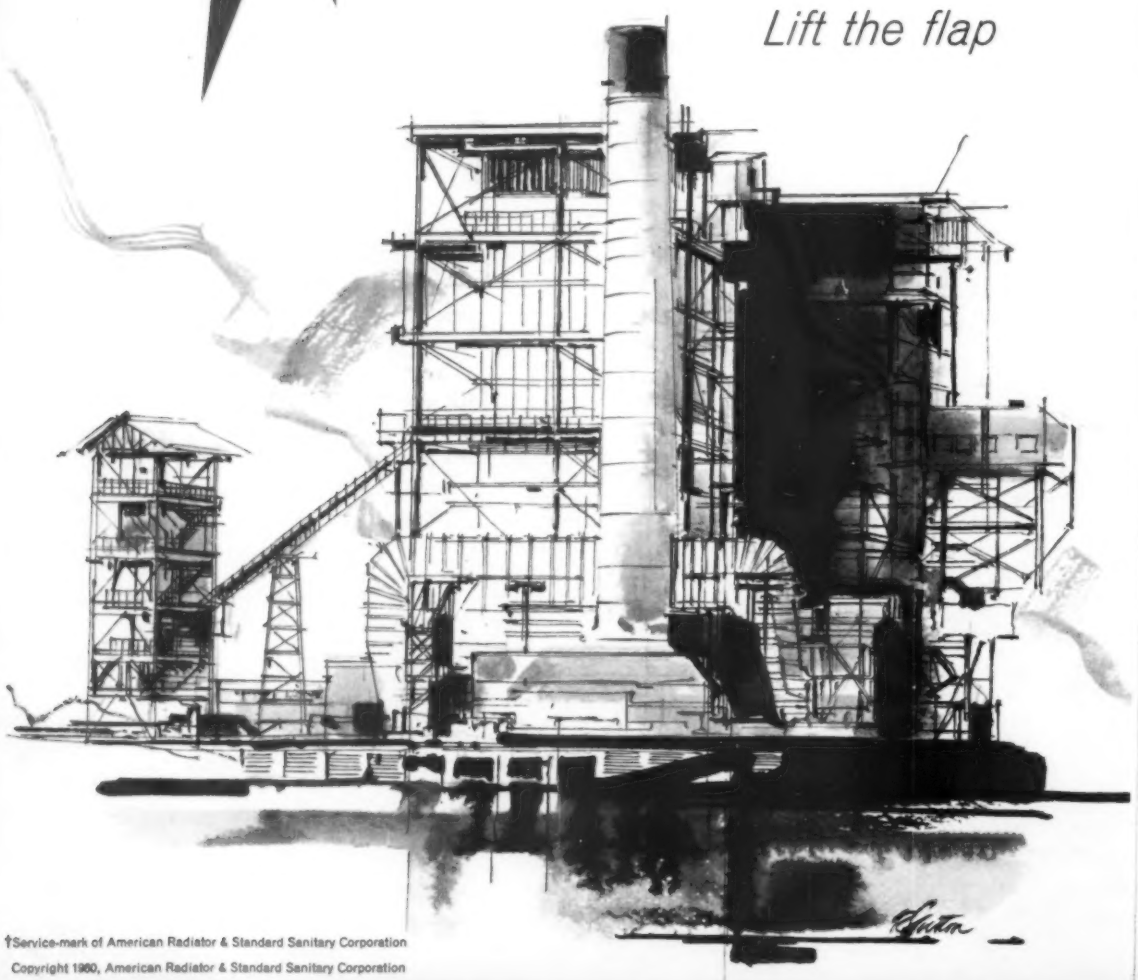
American-Standard feedwater heaters are compact, smaller in diameter than similar units. They're adaptable to vertical or horizontal application. They're unequaled in operating advantages to give your plant a Power-Lift . . . from the American-Standard Industrial Division.

From American-Standard Industrial Division

Power-Lift† for power plants through more rugged and simpler feedwater heaters

Power-Lift is a timely new concept of coordinated products and services from American-Standard Industrial Division. Its purpose is to help you raise overall efficiency in your plant. Its products are designed, engineered, and manufactured to a uniformly high standard of quality and performance... with service by product specialists in every major city. To see how Power-Lift can benefit you through simpler, more rugged feedwater heaters...

Lift the flap



Surfac
condenser

Mechanica
draft fans

Feedwater
heaters

†Service-mark of American Radiator & Standard Sanitary Corporation

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As near as your phone . . . **American-Standard Industrial Division Power-Lift Products and Services. Talk over your requirements with an American-Standard* Industrial Division product specialist. You'll find him well prepared and experienced —frequently able to base equipment recommendations upon precedents of proved success. And, in many instances, our comprehensive standardization paves the way to savings in time and cost. Offices in all principal cities. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario. Export Division, American-Standard, New York City.**

AMERICAN-Standard
INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

urface ensers Designed to service the largest of today's and tomorrow's steam turbines. Low bundle entrance velocity; liberal steam transportation lanes; moisture impingement grids to extend tube life; expansion diaphragms; effective deaeration and many other features created during 40 years of surface condenser development and research.

anical t fans Complete range of sizes and types for forced draft, induced draft, gas recirculating, and primary air fan applications. Designed to meet rigid requirements of modern power plants where maximum pounds of steam are produced daily at peak efficiency. Airfoil, forward curved, backwardly inclined, radial, radial tip blades.

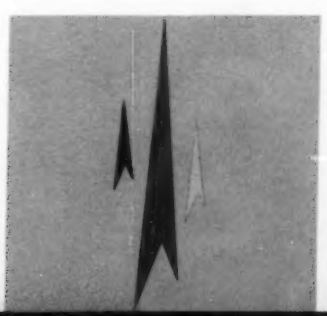
water eaters Design incorporates unique new High Pressure Closure. Maintenance is simplified with only four major parts. Exceptionally high safety factor built into all units—more than double ASME Code requirements. Temperature stresses from start-ups or load changes virtually non-existent.

Heat exchangers Designed and built with thoroughness and precision. Standard or specially engineered units for virtually all conditions and applications, including high pressure-high temperature exchangers, compressor inter- and after-coolers, fuel oil heaters, blow-down exchangers, and many others.

Gyrol® fluid drive Provides stepless adjustable speed control for fans and boiler feed pumps. Performance, power savings, and reliability proved in the field. Units for motor driven boiler feed pumps or for "on-the-shaft" duty on main turbine generator. Drives are available for fan and pump duties for all boiler sizes.

Fly ash and dust collectors Type "D" Dust Collector: mechanical "cyclone-type" collector. Series 342 Dust Collector: uses "cyclone" principle, with individual tubes which permit flexibility in design to fit plant layout. Series 361 Dust Collector: combines primary and secondary systems for high efficiency fly ash recovery.

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation



THE NEW, TIGHT-CLOSING PRESSURE REDUCING VALVE THAT *CAN'T FOUL*

If you like a simple, straight-forward solution to vexing valve problems, you're bound to be impressed with the new line of Leslie-Topper Pressure Reducing Valves. To avoid valve fouling, Leslie Engineers developed a tight-closing valve with an internal pilot that's completely out of the path of steam—*it just can't foul.* Let imaginative engineering simplify valve design and you get results.

Here's the one pressure reducing valve that handles poor steam conditions, intermittent or standby service better than any other valve. It provides high accuracy of regulation with negligible dead-end build up and costs only pennies for maintenance.

New, patented Leslie-Spiroflex* all metal diaphragm insures years of outstanding valve performance. It makes a long valve stroke possible in a packless design—there's nothing to leak, nothing to bind. It's time for a change when you can get rid of the cost and bother of fussy, old-fashioned pressure regulators.

*Trademark of Leslie Co.

Leslie-Topper Selection Table

Size	Inlet Pressure PSI	Adjustable Pressure Range PSI	CLASS		
			Cast Iron Construction	Bronze Body Construction With Iron Superstructure Castings*	All Bronze Construction
½" TO 1¼"	UP TO 150	2 - 10	GKLL	GLL	GBLL
	OVER 125	2 - 10	GKL	GL	GBL
	UP TO MAXIMUM BODY RATING	5 - 20	GKM	GM	GBM
		15 - 35	GKH	GH	GBH
1½" TO 2"		2 - 10	GKL	GL	GBL
		5 - 20	GKM	GM	GBM
	UP TO 150	5 - 35	GKHL	GHL	GBHL

*All parts in contact with controlled fluid are of bronze.

For sizing and capacity data write for Bulletin 582 or contact your Leslie Engineer—he's listed in the Yellow Pages under 'Valves' or 'Regulators'.

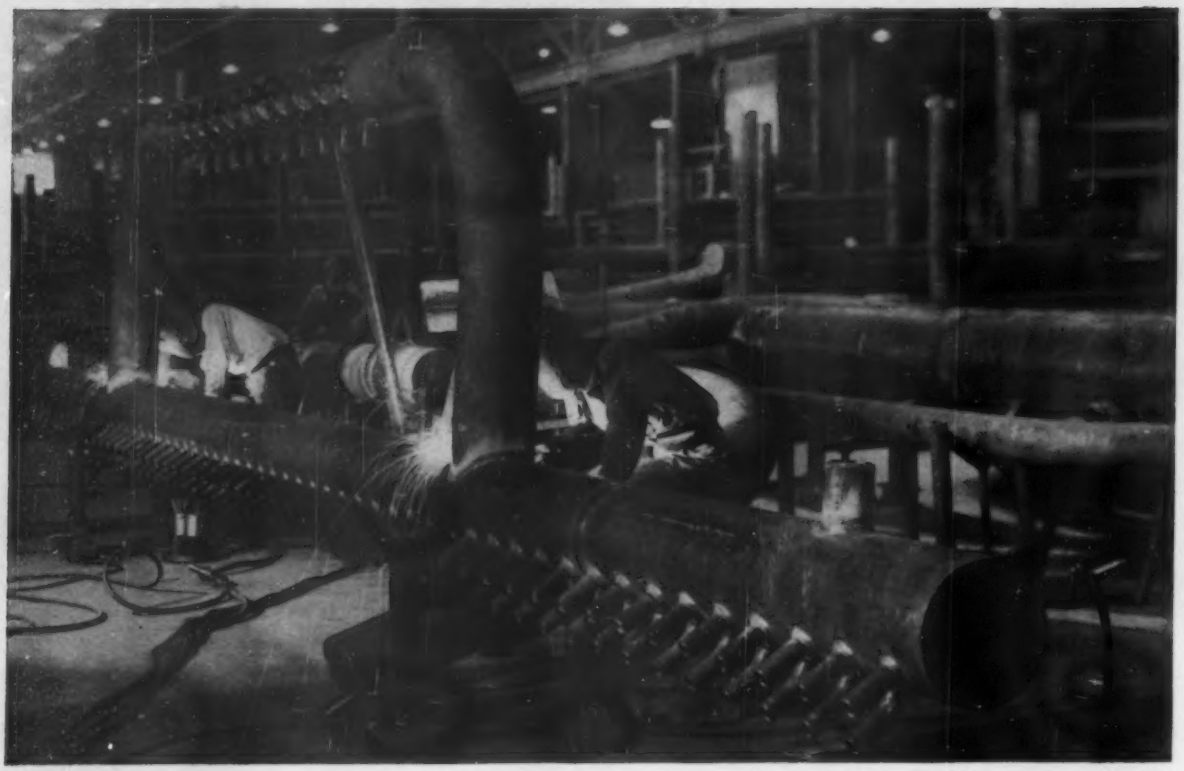
Leslie Co., 702B Grant Ave., Lyndhurst, New Jersey

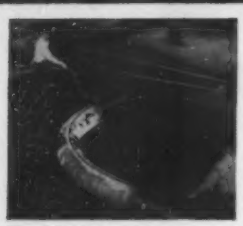
This new Leslie-Topper Pressure Reducing valve is a part of Leslie's expanding line of control valves, regulators and pilots for steam, air and liquids.

TRADE LESLIE MARK

REGULATORS and CONTROLLERS

EXACTLY as you want it . . .





Bending

Stress-relieving

Ultrasonic Testing

Shop-fabricated piping by Grinnell

With Grinnell shop-fabricated piping — cutting, fitting, welding, and assembly "on location" is reduced to an absolute minimum. That can be important. For when these operations are performed under the less-than-ideal conditions existing in the field, there is always the possibility of less-than-perfect results. For example, errors in cutting or fitting can occur — or welds can contain slight imperfections, which may be difficult to detect and correct with field equipment.

In Grinnell shops, on the other hand, whole sections of complex piping are assembled *exactly* as you want it — with every critical point checked with the latest equipment and by the most modern methods. When these sections arrive on site, they go up fast and *right.*

With Grinnell shop-fabrication too, there are no unforeseen costs. Included in the price (which is determined in advance) are such items of expense as: interpretive engineering, shop sketches and planning, procurement of materials, power services, expendable tools and supplies. There are no charges for waste material.

Consider the quality of the finished job, and final cost. Then consult Grinnell on *your* next piping installation.

To Engineering Societies and Departments: A 30-minute color sound film showing the quality and economy of Grinnell Shop-Fabrication of all classes of piping is available without charge. Contact your local Grinnell Supply Sales Office, or write to Grinnell Company, Inc. 216 West Exchange St., Providence, R. I.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

For more data circle 523 on Post Card

Check these improved
1960 insulations

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BALDWIN-EHRET-HILL

you'll want
them in your new specifications

Take a Fresh Look at **THERMASIL**

Calcium Silicate Insulation

Thermasil now offers more advantages than ever before. Take the matter of strength! The hardness of a calcium silicate should be sufficient to permit safe and easy handling, resist damage from vibration and accidental concussion—yet not be too hard, because low application costs depend on being able to use conventional tools. Only Thermasil has this ideal combination of strength and toughness. And there are other advantages in durability, "hinge strength," freedom from shrinking, warping and cracking.

Continuing product improvement by Baldwin-Ehret-Hill makes it essential to keep your ideas fresh - with timely, accurate knowledge of constantly changing insulation materials. You'll realize that old specifications are of little value in writing new ones for modern installations. Baldwin-Ehret-Hill offers you the complete line—a selection of over thirty specialized insulations for service from sub-zero to 1900 F. To bring your specifications up to date, write for our 1960 catalog or see it in your Sweet's Files.

NOW IS THE TIME TO UPDATE YOUR SPECIFICATIONS WITH . . .

BALDWIN-EHRET-HILL

200 Breunig Ave., Trenton 2, N. J.

THE COMPLETE LINE OF INSULATIONS for use SUB-ZERO TO 1900 F.

CONTRACT APPLICATION SERVICE FROM COAST TO COAST

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——Gas Tempering **Report No. 5**——

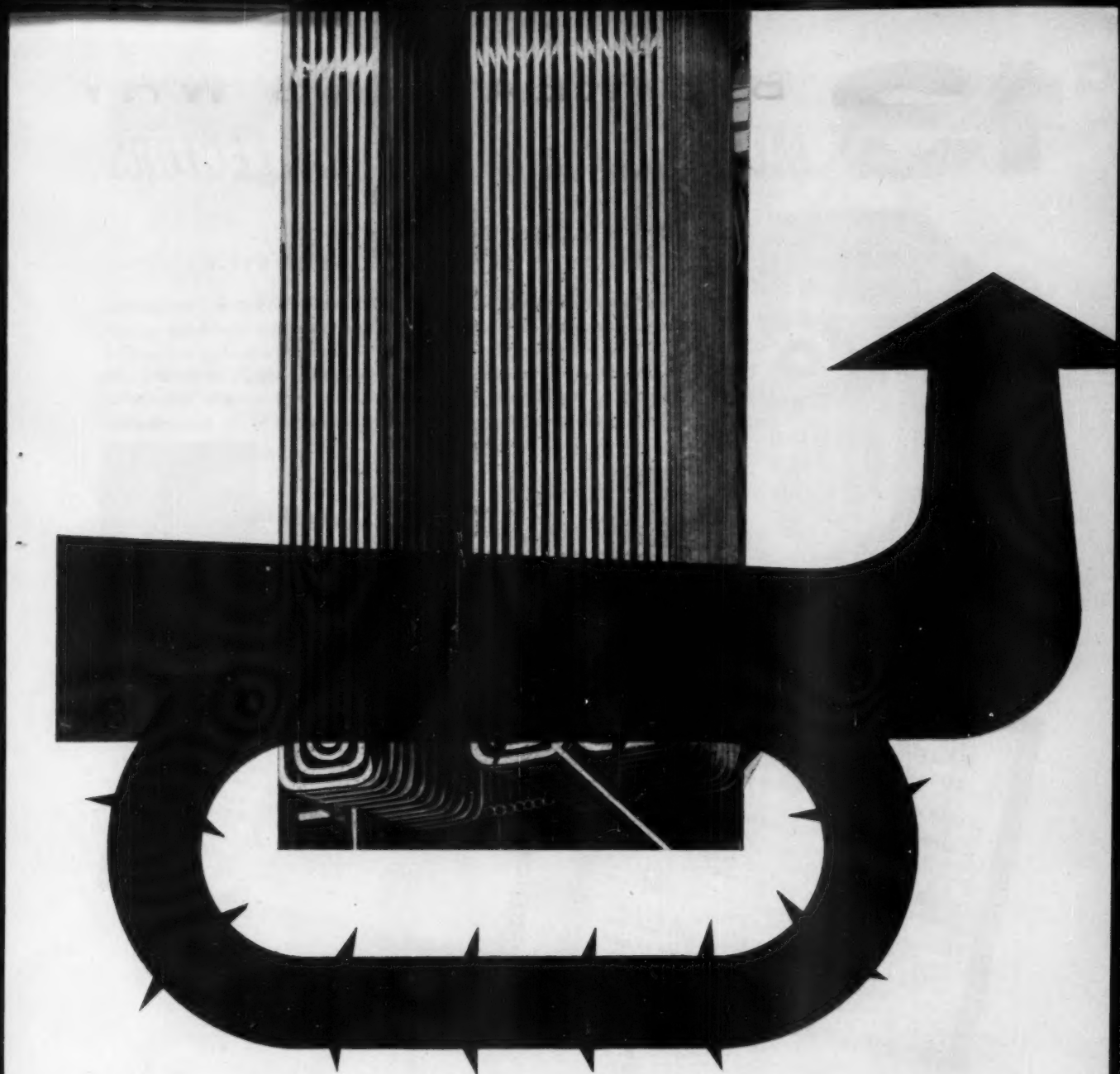
GAS TEMPERING

...its role in superheater protection

B&W perfected control principle supplies needed heat volume at lowered gas temperature . . . cuts superheater alloy requirements and reduces maintenance.

What is Gas Tempering? Gas Tempering is the introduction near the furnace exit of "cool" flue gases to mix with —and thus control—the temperature of furnace gases entering the superheater.

Though these cooler flue gases appreciably lower furnace exit gas temperature, total furnace or convection-pass heat absorption is little affected since weight and quantity of gas are increased.



How does Gas Tempering protect the superheater? The lower temperature of the gases entering the convection section a) greatly reduces ash fouling, corrosion and creep of the tube surfaces in the superheater, b) prevents "enameling" of ash on superheater tubes, c) reduces requirements for high alloys in superheater tubes, necessary with higher gas temperature.

Has Gas Tempering been proved in operation? YES! . . . Major B&W boiler installations all over the country are reporting excellent results with Gas Tempering. What's more, Gas Tempering has offered them many other important operating advantages in addition to superheater protection.

For the complete story on Gas Tempering—its relation to boiler design and operation plus typical case histories—write for B&W Bulletin G-96. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

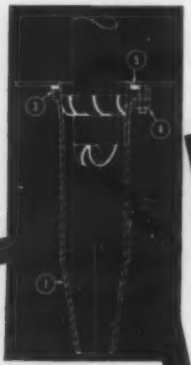
G-977

For more data circle 525 on Post Card

13 BIG REASONS WHY MULTICLONE FLY ASH COLLECTORS

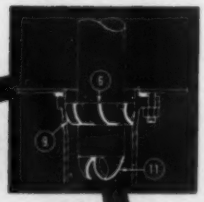
✔ COST LESS TO MAINTAIN...
✔ ARE FAR SIMPLER TO SERVICE!

When you buy fly ash collection equipment, don't stop with a comparison of *initial* cost only. Compare also the cost and simplicity of keeping your collector at top-notch efficiency *throughout the years.* To the outstanding advantages of Multiclone's unique operating features, add the low cost and easy maintenance of this equipment and you'll see why Multiclones are the leading choice wherever *centrifugal* types of fly ash collectors are the most practical solution.



EASILY INSTALLED COLLECTING TUBES

1. **CAST IRON TUBES** assure long wear!
2. **SPECIAL ALLOY TUBES** (FBA Inco #40, Chromehard and Ni-Hard) can be supplied where high temperatures or severe erosion are problems!
3. **TUBES ARE PRECISION-CAST** for exact fit into tube sheet. Tube lip protects sealing gasket!
4. **TIGHT LEAKPROOF FIT** of each tube is maintained indefinitely by special lock nuts!
5. **GAS-TIGHT JOINT** between tube sheet and each tube is assured by special gasket. Joint can be easily renewed when replacing tube!



PRECISION CAST VANES!

6. **CAST IRON VANES** resist erosion!
7. **SPECIAL ALLOY VANES** (FBA Inco #40, Chromehard and Ni-Hard) can be supplied where high temperatures or severe erosion are problems!
8. **VANES ARE EASILY INSTALLED** by simply dropping new ones into place when changing collecting tubes!
9. **EXACT FIT OF EACH VANE** in the tapered collecting tube prevents erosive "blow-by"!
10. **CAPACITY AND EFFICIENCY** of the unit can be quickly altered by simply changing vanes. Assures easy adaptability to new operating requirements—big savings in plant modernization programs!
11. **SPIROVANES** (energy recovery devices) may easily be added to outlet tubes of existing installations to increase capacity or reduce pressure drop!

Plus These Important Advantages...

12. **CUBIC SHAPE** of Multiclone is easier to install and insulate — and requires only ONE simple inlet and outlet duct!
13. **BACKED BY OVER 3300 INSTALLATIONS** serving a wide cross-section of industry, each Multiclone benefits from the unequalled "know-how" gained during Western Precipitation's **half-century** of leadership in the highly-technical field of modern fly ash collection!

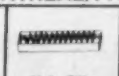
Compare the above advantages with any competitive equipment and you'll readily see why Multiclones are the logical choice for *your particular* operations, too. There's a Multiclone representative near you who will gladly supply further details to fit your individual requirements. No obligation, of course!

Send for descriptive literature on Multiclone equipment.

WP

WESTERN
PRECIPITATION
DIVISION OF JOY MANUFACTURING COMPANY

1000 WEST 9TH STREET, LOS ANGELES 54, CALIFORNIA
NEW YORK 17 • CHICAGO 2 • PITTSBURGH 2 • ATLANTA 5 • SAN FRANCISCO 4
IN CANADA: 8285 MOUNTAIN SIGHTS AVENUE, MONTREAL, P. Q.

Cottrell Precipitators	Multiclone Dust Collectors	Therm-O-Flex Hi-Temp Filters	Dualaire Reverse-Jet Filters	Turbulaire-Doyle Scrubbers	Joy Microdyne Scrubbers	Combination Units	 Holo-Flite Processors	Hi-Turbiant Heaters

For more data circle 526 on Post Card

FOR AUTOMATIC CONTROL OF STEAM STATIONS

An RW-300 system in a steam station can pay for itself by improving service continuity, increasing safety for personnel and equipment, and reducing operating and maintenance costs. RW-300 computer control can reduce the probability of major accidents, decrease the number of outages, and ensure faster return to service following an outage. In addition, through monitoring plant performance and computing heat rate, computer control can provide significant fuel savings.

Many utility leaders are now considering computer control of boiler-turbine-generator units, and uppermost in their minds is the question of system reliability. Field reliability can be proven only by on-line systems standing up under continuous service in rugged industrial environments. Every day more than a dozen RW-300 systems are operating around the clock in a variety of industries.

For further information, call or write Mr. Raymond E. Jacobson, Director of Marketing, Dept. PE-1077-1.

RW-300

the most field-reliable computer control system . . .

THE THOMPSON-RAMO-WOOLDRIDGE PRODUCTS COMPANY

a division of ***Thompson Ramo Wooldridge Inc.***

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Reporting more news from . . .

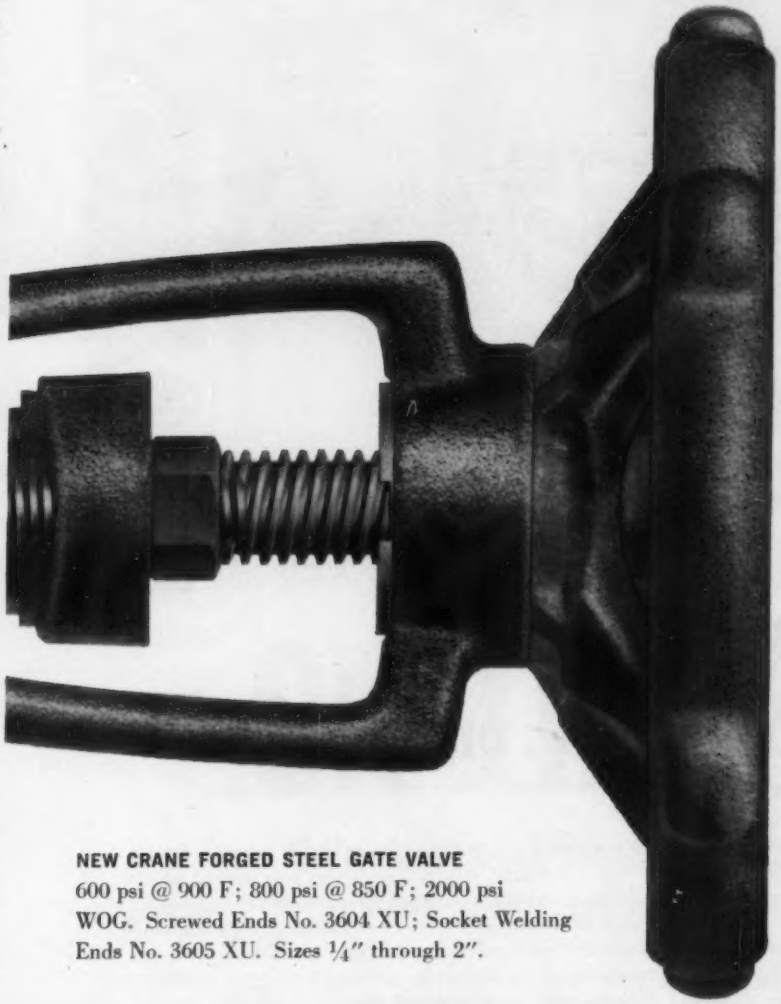
CRANE DIRECTION '70

. . . a fast-moving program of planned expansion, product development, and streamlined distribution to help our customers meet the competitive challenges of the Sixties.

COMPLETELY

REDESIGNED!

THE NEW SMALL FORGED STEEL GATE VALVE



NEW CRANE FORGED STEEL GATE VALVE
600 psi @ 900 F; 800 psi @ 850 F; 2000 psi WOG. Screwed Ends No. 3604 XU; Socket Welding Ends No. 3605 XU. Sizes ¼" through 2".

This is a whole new valve, not just one with a new feature added. This redesign incorporates all the features you told us you wanted plus a few others we know will make this valve a better buy in terms of longer service life, less maintenance, easier and faster servicing.

Like the new "bow-leg" yoke, which for the first time gives you plenty of hand room for easy stuffing box maintenance. And like the long-life braided asbestos packing, with Inconel wire insert. The "universal" trim that can be used for either oil or steam, eliminating many of your stocking problems. The spiral wound stainless steel bonnet gasket with asbestos filler, made blowout-proof with a male-female joint.

But what we really want you to remember, more than any single feature, is that this Crane valve is the newest—all new—valve on the market . . . well worth considering when you need small, high-pressure steel gate valves. We'd like you to compare this new valve with any other comparable valve feature for feature.

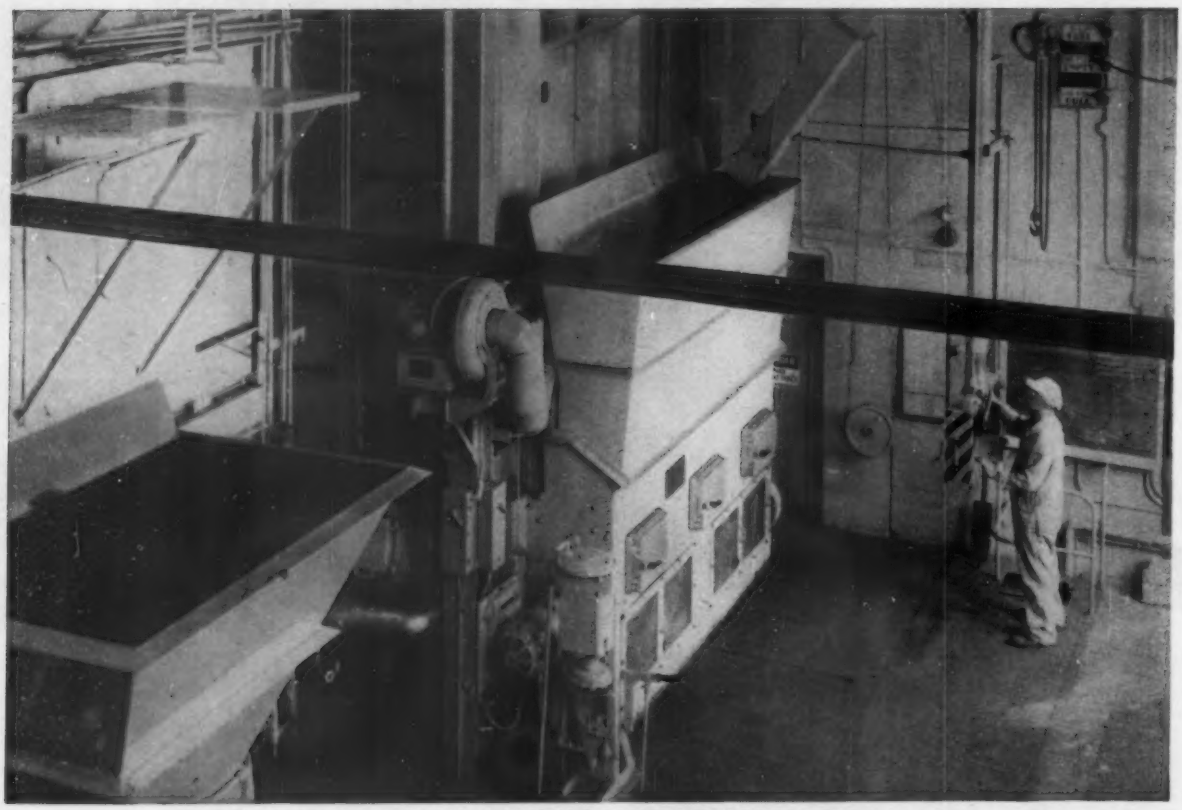
Your local Crane distributor has technical literature and a complete selection of these valves right in stock. Call him on small steel gates. In fact, he's your best bet to call no matter what valve you want because he carries the broadest line of quality valves in the world.

CRANE®

CRANE CO., INDUSTRIAL PRODUCTS GROUP
4100 S. KEDZIE AVE. • CHICAGO 32, ILL.
VALVES • ELECTRONIC CONTROLS • PIPING
PLUMBING • HEATING • AIR CONDITIONING

For more data circle 528 on Post Card

at S. C. Johnson & Son, Inc.



On the line in October 1954, this 40,000-lb B&W boiler, fired by AE Vibra-Grate Stoker, has never had an unscheduled shutdown. Cost of repairs to previous stokers ran close to $1000 per year.

Five-year repair bill for Vibra-Grate Stoker...only $188!

(vs previous stoker costs of $1000 a year)

The AE Vibra-Grate Stoker installed at S. C. Johnson & Son, Inc. (makers of Johnson's Wax Products), Racine, Wisconsin, continues to prove every performance promise ever made for Vibra-Grate Stokers.

Read these highlights from the company's *five-year* maintenance report, just released:

No unscheduled shutdowns. Savings of 919 tons of coal per year. No fly ash collector needed. No trouble with clinkering or coking coals. Peak efficiency at plant loads from 4000 lb per hour to 45,000 per hour. Load swings of 15,000 to 20,000 lb with only 3 to 4 lb variation in pressure.

Finally, total repair costs only $188, while burning 34,962 tons of coal . . . just slightly over ½ cent per ton of coal!

The AE Vibra-Grate Stoker is the only stoker which combines the long life and low maintenance of water-cooled grates with the high efficiency of vibrating grate feed and controlled zone undergrate air. No other stoker cuts maintenance costs so drastically, gives such highs in efficiency. Get the complete design and operating story. Write today to Dept. S-101 for our Vibra-Grate Stoker Catalog S-546-A.

AMERICAN ENGINEERING COMPANY
Division of United Industrial Corporation
Wheatsheaf Lane & Sepviva St. • Philadelphia 37, Pa.

Canadian Subsidiaries: Affiliated Engineering Corporation, Ltd., Montreal, P. Q. • Bawdin Industries Ltd., Toronto, Ont.

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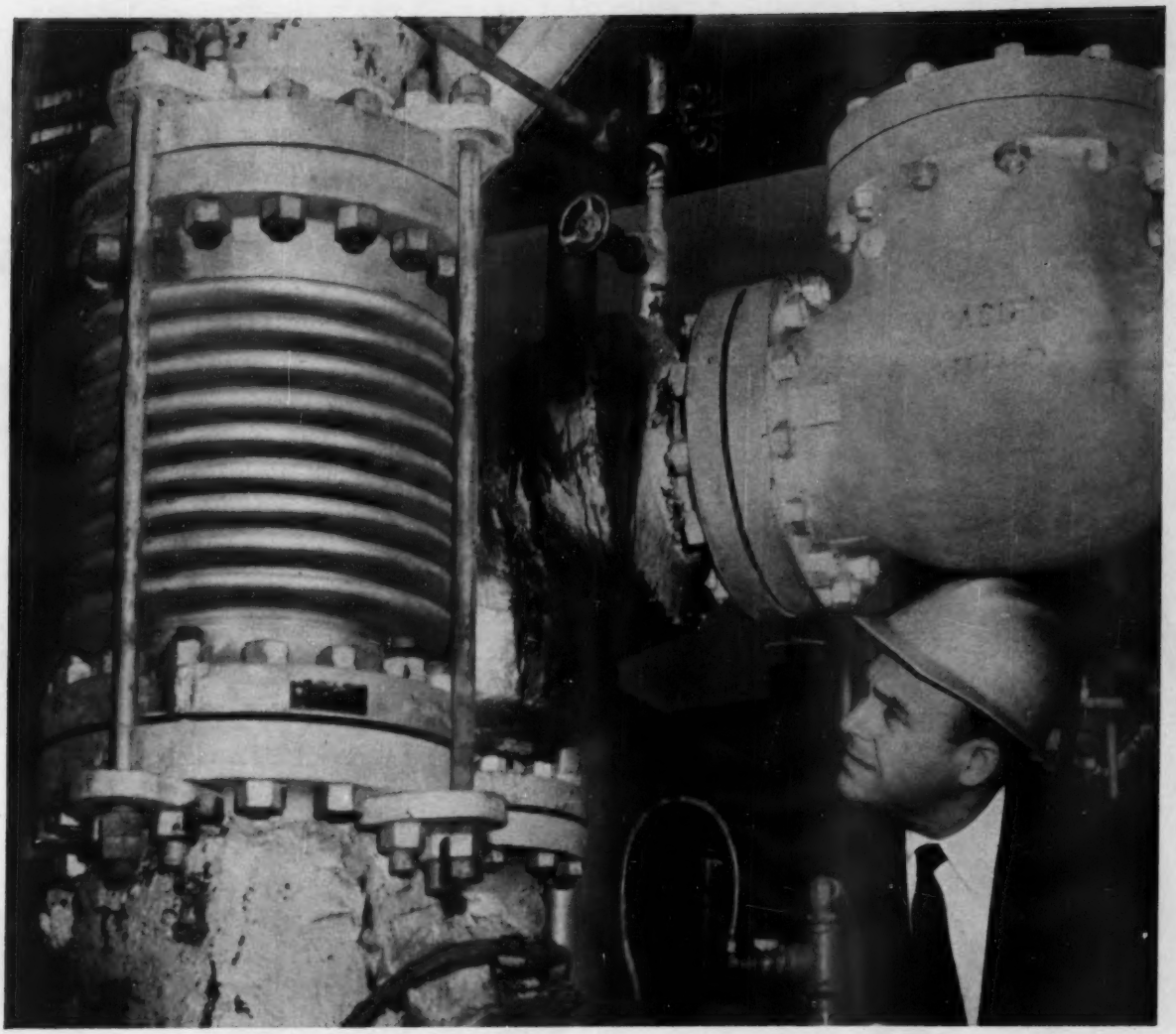

ON THE SPOT

Solar's experienced field engineers can serve you anywhere...faster!

THIS 10 IN. SOLA-FLEX® expansion joint is one of three such joints installed by Fluor Corporation in the Champlin Oil & Refining Co. plant ten miles west of Driscoll, Texas. The man in the picture is Roy Horlock, Solar field engineer.

Wherever you are located in the United States there is an experienced Solar field engineer nearby – ready to give immediate *on the spot* technical assistance on your expansion joint problems. This prompt, efficient service is just one of the many reasons why forty of America's fifty largest businesses rely on Sola-Flex expansion joints.

Solar manufactures the most comprehensive line of expansion joints in the world. They are made from a wide variety of stainless and high-temperature alloys in a complete range of sizes from ½ in. to 35 ft in diameter. Temperatures range from –320F to 1200F, pressures from full vacuum to 600 psi and up.

For information write to Dept. H-142, Solar Aircraft Company, San Diego 12, California.

SOLAR
AIRCRAFT COMPANY
A subsidiary of International Harvester Company

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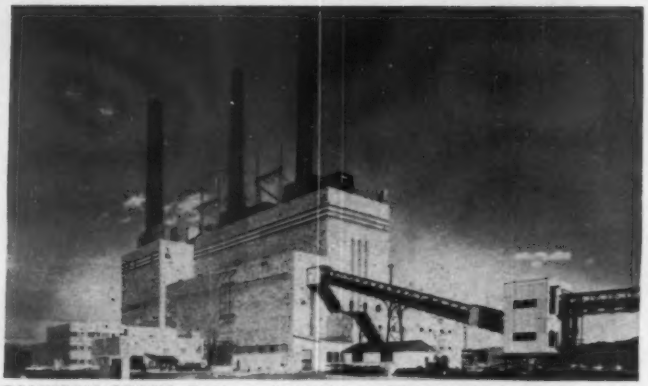
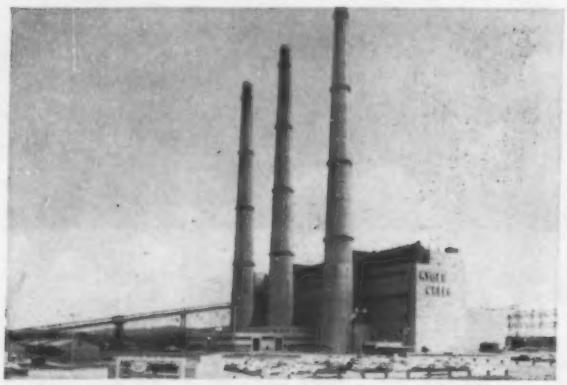
PROOF OF PERFORMANCE

FPC's list of "most finds Bailey users

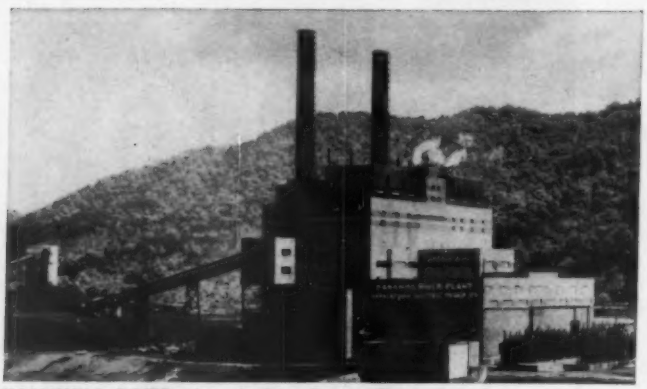
ST. CLAIR (The Detroit Edison Co.)—top 11, 1954-1958, averaging 9222 Btu/kwhr.



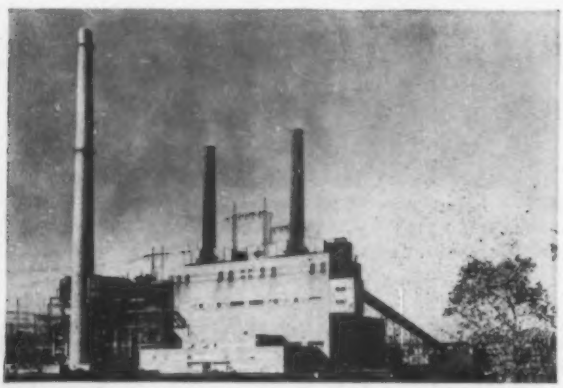
TANNER'S CREEK (Indiana & Michigan Electric Co.)—top nine, 1954-1958, first in 1956, averaging 9204 Btu/kwhr.



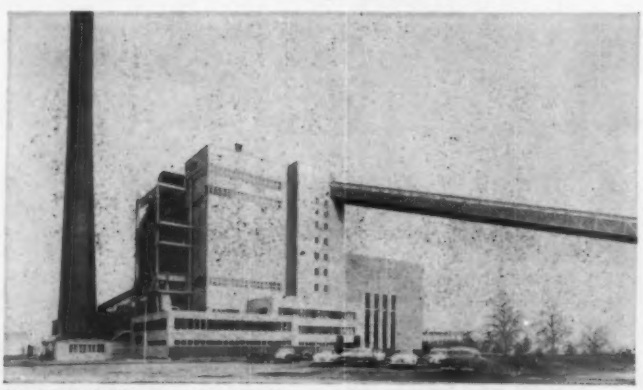
KYGER CREEK (Ohio Valley Electric Corp.)—top six, 1955-1958, first in 1955, averaging 9164 Btu/kwhr.



KANAWHA RIVER (Appalachian Power Co.)—top three, 1954-1958, first in 1954 and 1957, averaging 9128 Btu/kwhr.



MUSKINGUM RIVER (Ohio Power Company)—top five, 1954-1958, averaging 9216 Btu/kwhr.



BAY SHORE (The Toledo Edison Co.)—top ten, 1956-1958, averaging 9241 Btu/kwhr.

efficient plants"
as consistent repeaters

Thirteen of the 15 most efficient power plants on the Federal Power Commission's 1958 list use Bailey Meters and Controls.

For most of these plants, this marks the fourth or fifth consecutive year of top-ranked operating economy.

It is significant to engineers responsible for steam plant design and operation, that so many of these top performing plants are using Bailey Meters, Combustion Controls, Feed Water Controls and Superheat Controls.

Today, for breadth of product line, depth of experience and leadership in practical plant automation, no one can offer more to the power industry than Bailey. To apply Bailey's capability to your specific needs, check with the Bailey District Office or Resident Engineer listed in your phone book.

A145-2

Instruments and controls for power and process

BAILEY METER COMPANY

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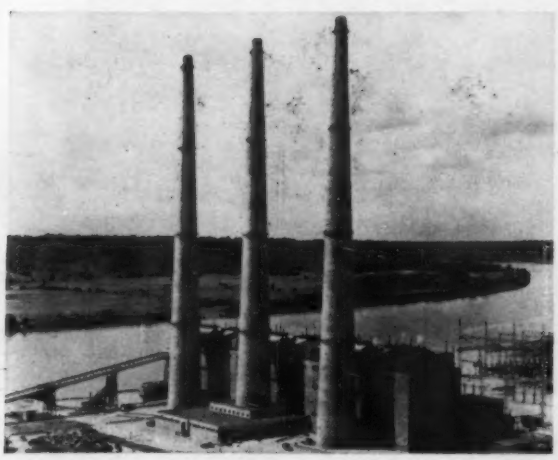
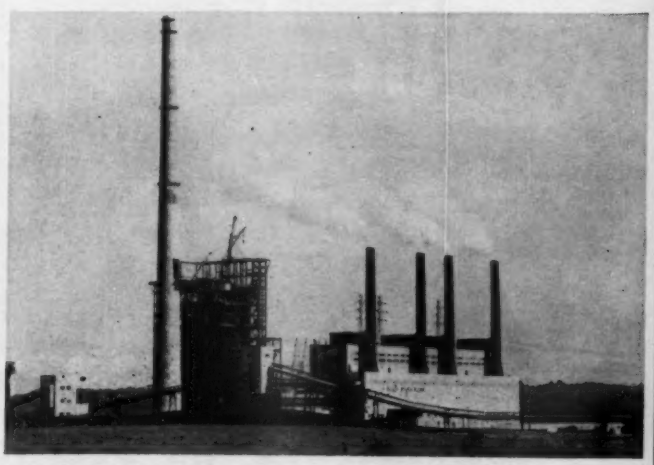


CLIFTY CREEK (Indiana-Kentucky Electric Corp.)—top five, 1955-1958, averaging 9155 Btu/kwhr.



PHILIP SPORN (Appalachian Power Co.—Ohio Power Co.) —top fifteen, 1954-1958, averaging 9378 Btu/kwhr.

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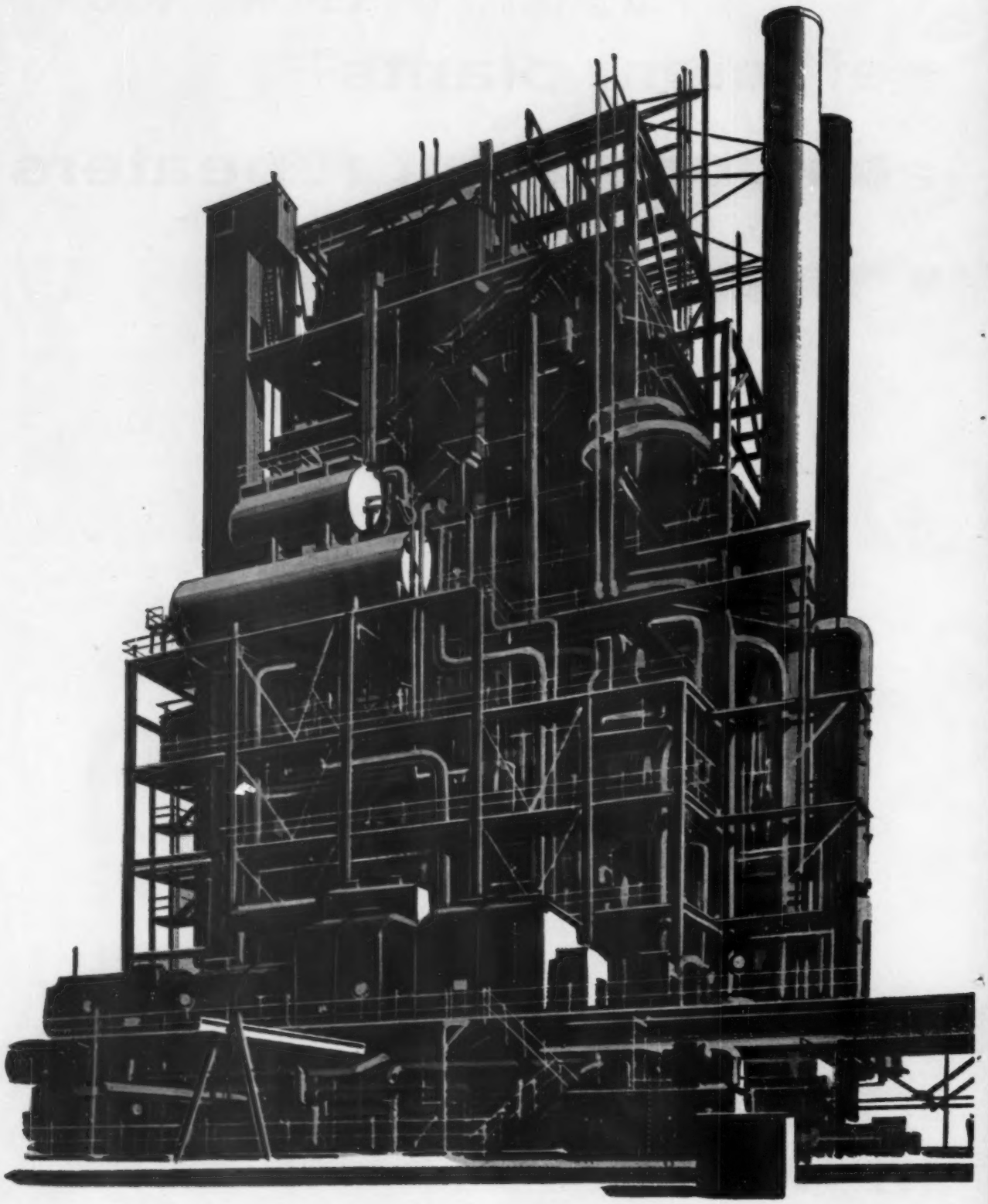

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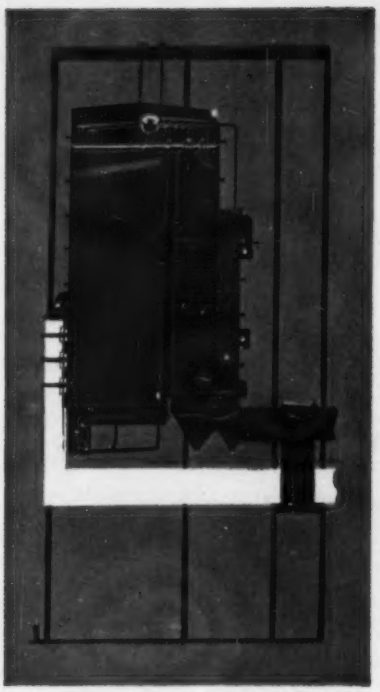

A word about steam generators

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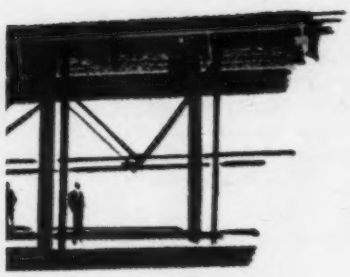

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HAGAN NEWSLETTER—AUGUST

Behind the panel

HOW "CENTRALIZED CONTROL" ADDS DRAMATIC EXTRAS TO OPEN HEARTH DUST COLLECTION

A major Pittsburgh steel producer, cooperating with the city's air pollution control program, is installing electrostatic precipitators on eleven open hearth furnaces. Hagan PowrMag electronic controls, Ring Balance meters, and a Kybernetes TIM (temperature indicating monitor) are playing an important role in the over-all automation of the eight precipitators, and the eleven waste heat boilers that cool furnace gases ahead of the precipitators.

The steel company will obtain these positive benefits from the system; benefits that were taken into account when justifying the initial investment:

1. Effective control of troublesome open hearth dust.
2. Recovery of iron ore from the dust.
3. Bonus steam from the waste heat boilers.
4. Most important of all, intelligent automation of the process to minimize operating costs.

THE CONCEPT OF CENTRALIZED CONTROL IN ACTION

Early planning for the job envisioned a control panel at each boiler and precipitator. However, when operating and supervisory requirements were spelled out, the thinking quickly evolved towards complete centralization of control. Hagan PowrMag (solid-state, magnetic) controls reach out from a single 80-foot control house to control equipment spread out over an open hearth shop more than ¼-mile long.

The Hagan Kybernetes TIM (the steel industry's first, for this process) will provide high-speed warning if any of 220 critical gas, bearing, or steam temperatures get out-of-limits; it will also monitor various pressures and levels. Thus, the operator has continuous, automatic supervision of the plant from the central control house.

A graphic control panel will present clear operating information at all times, and further centralize the operation of the coordinated systems. (Details on request--ask for Item 0-1.)

80,000 POUND--500 MPH TIRE TESTER HAS HAGAN CONTROLS

The control system is programmed to simulate all of the strains aircraft tires could possibly encounter, including the tremendous impact and yawing which occurs at touchdown on a landing field. Other programming puts the ties through taxiing and take-off tests. A tire may be accelerated from zero to 320 mph in less than 20 seconds under 30,000 pound load. Control systems for the four similar units include: PowrAmp amplifier, a model CPM controller and Hagan electro-hydraulic pilot valves. These Hagan controls have performed beyond expectations on this unusual equipment. (Details on request--ask for Item 0-2.)

"DOUBLE PLAY" SOLVES MOLYBDENUM PRODUCTION PROBLEM

A variation of the classic double play solved a tricky problem for a major molybdenum producer. In this case, it was Hall to Hagan to PowrMag, and here is how it came about. The ore is reduced by the flotation process. The plant found that production was falling off by as much as 5% daily (20,000 lb/day). They asked a Hall Laboratories industrial water consulting engineer for help. Working with plant personnel, the Hall man determined that raising the pH of the mix would stabilize production at the desired high level. This was accomplished by hand-feeding lime slurry, but manual control proved both time consuming and inaccurate. At this point the Hall engineer called on his Hagan counterpart for an assist, since the obvious solution was to make pH control automatic. And here the third member, the Hagan PowrMag (magnetic amplifier) controller, entered the play. Key element in a control system which provides for every quirk in the process, including the substantial cyclic process time lag, the PowrMag controller impressed both management and operating personnel with its simplicity and reliability. Since the entire system, including valve operators, is electronic, installation and maintenance will be simplified. The automatic pH control system is the first step in the automation of a process which tradition has regarded as requiring expert manual control. (Details on request--ask for Item 0-3.)

HAGAN CHEMICALS & CONTROLS, INC., Hagan Center, Room 714, Pittsburgh 30, Pa.

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How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

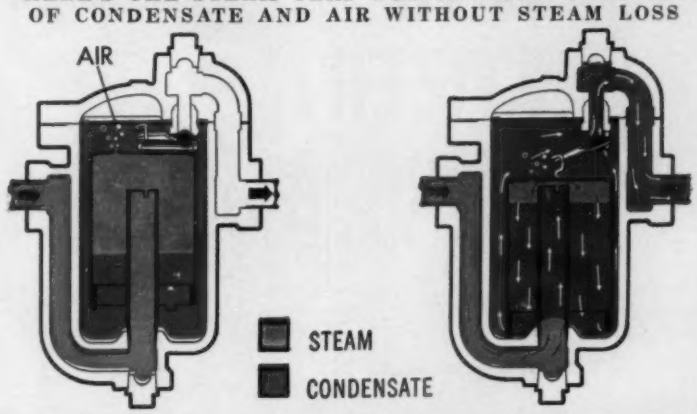
By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

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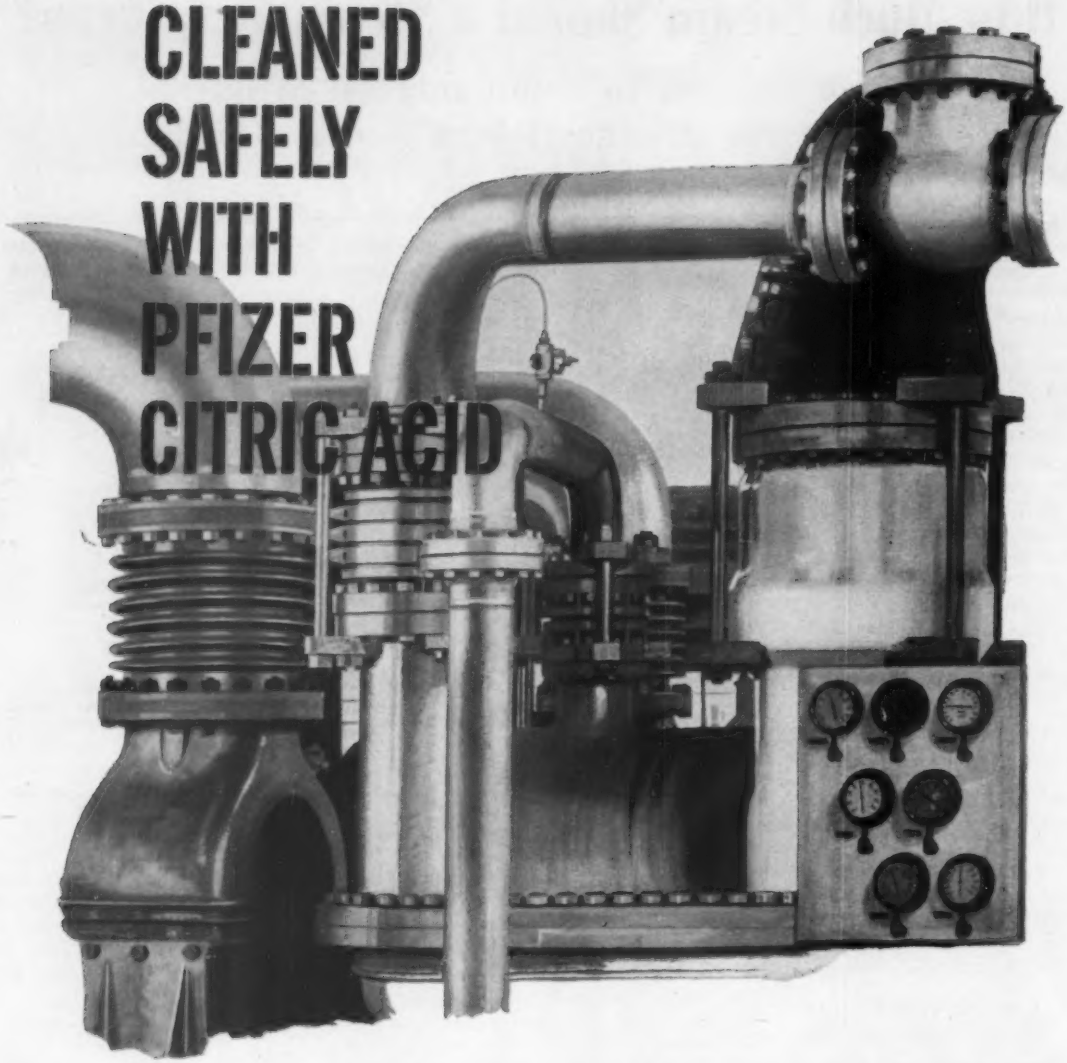

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3 Citric acid cleaning eliminates the problem of chloride stress corrosion.

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ATOMICS

A section of POWER ENGINEERING covering current and forthcoming developments in the field of Nuclear Power throughout the world

ANDREW W. KRAMER
Editor

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LARGE-SCALE USE OF FISSION PRODUCTS

THERE IS LITTLE DOUBT that the most important single problem arising from the increasing use of atomic energy for peaceful purposes is how to dispose of the growing quantities of radioactive wastes. This, as has been pointed out in ATOMICS (Nov '59), constitutes the industry's greatest headaches.

It is encouraging, therefore, to learn of the effort that is being made in the development of possible large-scale uses of separated fission products. As used here, the term large scale means operational quantities in the range of megacuries, which exceeds present availability and market. According to the results of a study made by the AEC, there are a number of possible applications of separated fission products which may lead to large-scale uses during the next 5 to 10 years. These applications involve the use of these radioactive materials as tracers in industrial processes, as phosphors in electroluminescent equipment, for gauging thicknesses in industrial production, in massive radiation sterilization of food and pharmaceutical products, for chemical conversion and, in the production of power.

Although there have been applications of radioisotopes in all of these areas, the quantities used have been very small. What is needed is their use in very large quantities—quantities comparable to those that will be produced by power reactors when nuclear plants become numerous. There is little doubt concerning the technical feasibility of some of the proposed large-scale uses of these fission products; the question is largely one of economics, and safety. Ionizing radiation is not yet an important tool in industry because it has not yet been demonstrated that its use offers sufficient advantages over established methods which achieve a similar result. Here the established methods are competitors, e.g., heat and chemicals to produce specific reactions in industrial processes. The competition exists largely on the basis of relative present-day costs combined with the technology and facilities already established.

According to a report by Arthur D. Little, Inc, the earliest major application of radionuclide fission products in quantities of hundreds of thousands or millions of curies appears to be for novel power sources for Government projects in remote locations. The long life of such power sources makes logistics economics more favorable relative to more conventional sources, and safety considerations are not so acute.

This question of the large-scale use of fission products is the subject of a recent AEC publication (TID-8521), available from the Office of Technical Services, Department of Commerce, Washington, D. C., at 50 cents per copy. This report points out that although the utilization of large quantities of radioisotopes is still in its earliest stages, possible large-scale uses are developing and that substantial changes can be expected during the next few years.

Andrew W. Kramer

Power and Heat From Reactors in Sweden

Although almost totally lacking in fossil fuel deposits, Sweden has extensive shale deposits in its central part which contain uranium. A small extraction plant has been in operation since 1953, but larger plants capable of meeting Swedish atomic energy needs are expected to be in operation by 1964

SWEDEN has practically no deposits of coal or oil, therefore it is necessary to import fossil fuels to cover the greatest part of its total energy needs. More than one third of the imported fuel is used to heat homes during the long winter season. Some of the larger cities have built central heating systems for whole districts of apartment houses, supplied from oil-fired heating stations in the region of 100-Mw thermal power capacity, and in most cases these are equipped with back-pressure turbines for the simultaneous generation of heat and electricity.

For the generation of electricity, Sweden has relatively large resources of water power. At present about 95 per cent of the electric supply comes from hydro stations. Electric consumption, however, is increasing at a rate of 6 to 7 per cent per year, and it is expected that this rate of increase will continue for at least the next 10 to 15 years. During this period the continued development of water power will proceed, at first in step with the increase in consumption, but later at a slower rate, until around 1980, when all the economical water resources will have been harnessed. The anticipated gap between supply and demand will have to be covered by means of thermal power stations, either conventional oil- or coal-fired units or nuclear power stations. The demand for extra power resources will become acute around 1970. It has long been recognized that this need for thermal power, if translated into corresponding importation of fossil fuels, would add a heavy burden to Sweden's balance of trade. The recognition that nuclear power constitutes the only means by which this situation could be eased thus forms a fundamental motive for Sweden's nuclear energy work.

The goal for the Swedish nuclear development work is thus twofold. First, efforts have to be made to develop a reactor system suitable for the construction of large nuclear power plants that will be economically competitive with conventional steam or gas power plants in the 1970's. Second, there is need for developing reactors of various sizes for heating purposes, suitable for economical use in competition with fossil fuels.

R3/Adam

The first Swedish reactor plans therefore aimed primarily at the supply of district heating with the generation of electricity as a by-product. It was first planned to build near Stockholm one reactor, called R3, to be used for both heat and power production, and another to be called Adam, for heat only, in Vasteras in central Sweden. The plans were later modified and the two projects have been combined. The combined power-heat station (R3/Adam) is now being constructed at Agesta, several miles south of Stockholm. During its initial operational period the reactor will have a thermal power of 65 Mw. Ten mega watts of electricity will be generated in a back-pressure turbine, and 55 Mw of heat will be delivered for district heating purposes. The output will later be doubled through the further addition of heat exchangers.

The R3/Adam reactor will be of the pressurized heavy-water moderated and cooled type. Its fuel will be natural uranium oxide canned in zircaloy, and it is expected to heat initially more than 10,000 homes in a newly built suburb of Stockholm. Construction started in November, 1957, and it is planned that the station will go critical in 1962. As shown in Fig. 1, the heavy water enters the reactor at a temperature of 205 C (401 F) and a pressure of 33 bars (480 psi), is heated in the coolant channels to a temperature of 220 C (4.18 F), and then enters the moderator and reflector space. After leaving the reactor, it is cooled at a temperature of 205 C in the heat exchangers, which generate saturated steam at the relatively low pressure of 13.5 bars (194.4 psi). This steam drives a back-pressure turbine and is then condensed in the heater for the district heating circulating water.

As shown in Fig. 2, it is intended after some years of operation to increase the reactor power from 65 to 125 Mw of heat by the addition of

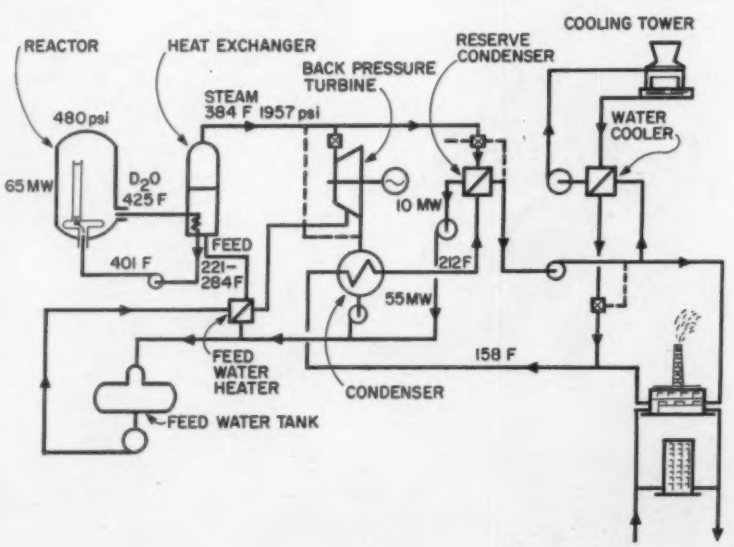

Fig. 1. Nuclear power system at R3/Adam, stage 1

further coolant loops. At that stage it is probable that the old back-pressure turbine will be replaced by a new extraction turbine and that an oil-fired superheater will be installed.

The station will then be able to generate 47 Mw of electricity (45 Mw net output) with pure condensing operation and 36 Mw of electricity when supplying 70 Mw of heat to the distribution water. Seventy tons of heavy water and 15 tons of natural uranium in the form of UO_2 will be used.

According to present estimates, the reactor should be just critical with natural uranium, and should achieve a burn-up of around 4000 Mwd/ton if the fuel elements are changed as entire units, and nearly 7000 Mwd/ton if the upper and lower halves of the fuel elements are interchanged after half the irradiation has been attained. In view of the lack of experimental data with hot heavy-water systems, some uncertainty exists however with regard to the reactivity calculations.

Location and Building

An interesting feature about this nuclear power station is the fact that the reactor, coolant and auxiliary circuits and the control room for the station are located underground in a chamber excavated in the rock, whereas the turbine generator unit and water purification plant are located above ground. Locating power stations underground is quite usual in Sweden for technical reasons in the case of water power stations and, since the last war, as a precaution against possible attack from the air in the case of thermal stations. In the case of R3/Adam a factor contributing to the selection of an underground location was protection of the surroundings against radioactivity.

The rock outcrop selected for the station location is about 3 km south of the Farsta suburb of Stockholm, and represents a compromise between the desire not to be too close to populated areas for reasons of safety, and the need to be not so far away to make heat transmission costs by pipelines excessive. Only a handful of cottages exist within a radius of 1 km and a very small population within a radius of 2 km from the site, and no further building will be allowed in this area without special sanction from the authorities. A small lake about 2.5 km from the station is used as a source for coolant water and as a recipient for purified waste water. Some limitations in the use of this lake exist in view of the low water level during particularly dry seasons.

Although in the case of good rock and good rock cover rectangular chambers can have a width of up to 30 m (98 ft), the quality of the rock at Agesta limited the permissible width to about 16.5 m (54 ft approx.). The length of the reactor hall is 53.5 m (175 ft), the maximum height is 40 m (131 ft), and the minimum depth of the rock cover above the hall is 15 m (49 ft). To increase still further the degree of protection of the surroundings against radioactivity, the reactor hall is lined with welded steel plate.

Mechanical Design of Reactor

Figure 3 shows a cross section of the reactor. The heavy water enters this vessel through four 350 mm (13.75 in.) inlet ports at the bottom, emerges into a stainless-steel distribution header, flows upward through the 140 fuel elements, and then returns downwards through the moderator space, and through a penetration in the coolant header, finally leaving the pressure vessel through the four outlet ports. Having the moderator located after the fuel elements in the circuit ensures that any reduction in flow velocity will increase the moderator temperature and will assist in shutting down the reactor by virtue of the negative temperature coefficient of the moderator.

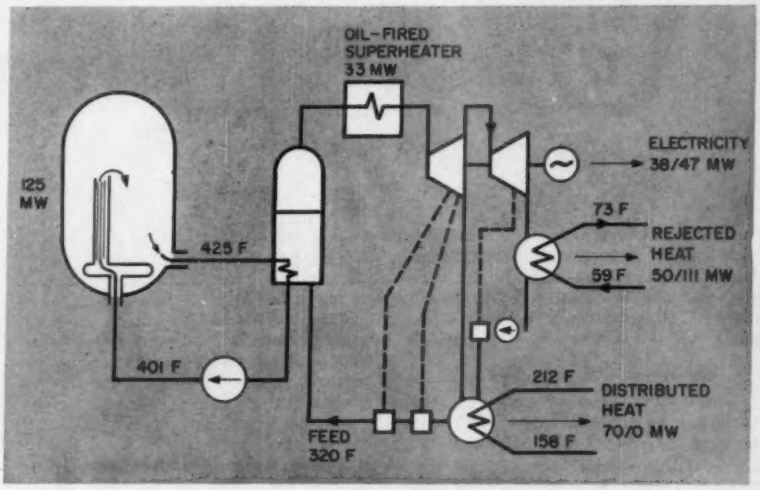

Fig. 2. Proposed system for stage 2

The pressure vessel, designed for 40 atm (588 psi) pressure, is of mild steel with a stainless-steel liner. The top head takes the form of a cellular lid comprising two main horizontal plates separated by a grid of stiffening plates. The interspace is filled with light water to provide shielding and temperature control of the heavy masses of metal involved. The bolted closure between the top head and the vessel contains a gasket, and a welded toroidal ring provides a positive seal. The good shielding will allow removal of the lid and remaking of the joint to be carried out without the use of remote handling machines, and this has been an important factor in the selection of the type of lid for this first Swedish station.

The design provides for two regulating rods and 28 shim rods, 7 of which also serve as safety or shut-down rods. These are actuated by step-motors and fall into the core under the action of gravity if the safety circuit is interrupted.

An interesting feature of the design is the fact that there is only one fuel element port to every four fuel elements, a design chosen in order to simplify the lid. Fuel elements are removed by inserting the relatively simple manipulator, Fig. 3, through the fueling port, lifting the fuel element from the shelf on which it hangs, centralizing it below the port, and then withdrawing it into the lead-shielded fueling flask. This flask is cooled by a gas circuit, while a spray of heavy water can supply emergency cooling in the unlikely event of the element becoming jammed during the lifting operation.

Each fuel element contains four 30-in.-long subassemblies, consisting of 19 rod bundles of 18.6 mm (approx 0.78 in.) OD rods with a supporting shroud of Zircaloy 2. The rods are built up of 17 mm (0.67 in.) UO_2 pellets which are centerless and end ground before being loaded into the 0.7 mm (0.028 in.) thick Zircaloy 2 cans. The rods in each bundle are supported at one end by a rigid, perforated Zircaloy 2 plate firmly attached to the shroud plate and giving a center-to-center distance of 22 mm (0.865 in.) between rods. At the other end of the bundle, provision is made to allow a restricted amount of relative movement and axial expansion between individual rods. Two additional wire spacers are provided for each bundle.

The desire to achieve a very high standard of safety in order to pioneer the location of district heating reactors close to load centers has been

ATOMICS

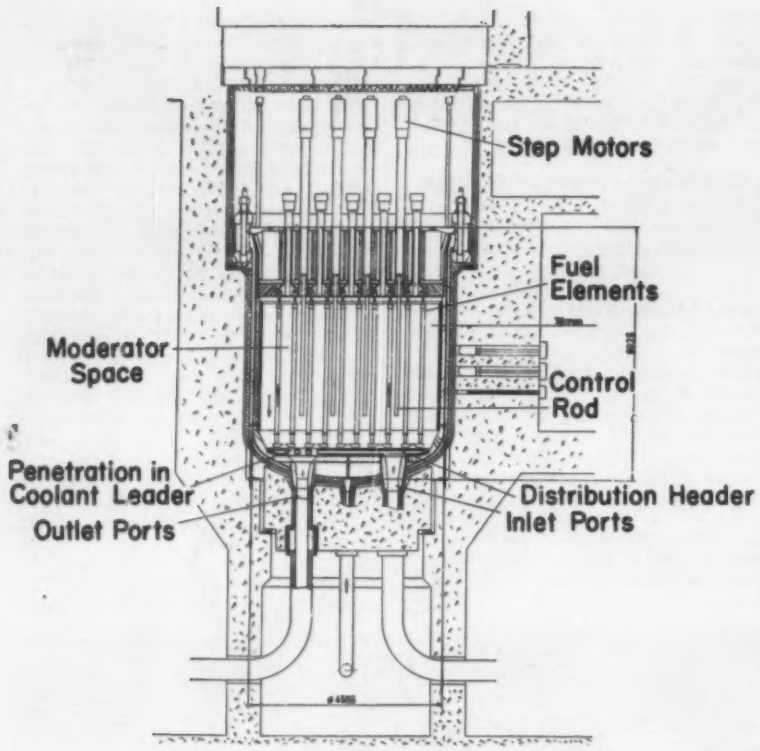

Fig. 3. Section through the R3/Adam reactor

reflected in the selection of relatively high safety margins in the thermal design, and a multiplicity of safeguards can be reduced in future stations, thereby reducing costs somewhat.

External Coolant System

The heat is removed from the reactor by four coolant loops, each containing one vertical-type heat exchanger, one canned pump, and two shutoff valves. Space is left for four additional coolant loops for stage 2 operation. The pressure in the system is maintained by a pressurizer containing about one cubic meter of water and 19 cubic meters of steam. To raise the pressure, the water inside the pressurizer is heated by electrical heating elements, while the pressure can be lowered by switching on a spray of cool D_2O.

With full load on the reactor, the four heat exchangers used during stage 1 deliver 105 tons of saturated steam per hour at a pressure of 184 psig and with a maximum water content of 0.5 per cent.

The turbogenerator used during stage 1 is a modified unit originally designed for condensing operation with a nameplate rating of 15 Mw at 100 per cent power factor. With full load on the reactor the unit will be capable of delivering 8 Mw of electricity at 6.3 kv under normal winter conditions, which corresponds to a heating water delivery temperature of 100 C (212 F), and 10 Mw of electricity during the summer, when the heating water temperature can be reduced to 75 C (167 F). Higher exit temperatures than 100 C cannot be tolerated because of expansion problems in the low-pressure part of the turbine.

The condensate leaving the turbine is collected and deaerated in a feedwater tank at 110 C, into which hydrazine is fed as the only water treatment for the feedwater. Two feedwater pumps driven directly by electric motors pump the water through one high-pressure feedwater heater which raises the temperature to about 160 C at the entrance to the main heat exchangers.

On the steam side, the turbine is shunted by a reserve condenser, which is connected in series with the main condenser on the water side. This reserve condenser enables the reactor to operate even when the turbine is out of action, or when a surplus of water power makes electricity generation by thermal station uneconomic. Furthermore, it can be used for dumping steam while the turbine is being started or stopped, or during a rapid turbine shutdown. The latter application requires that there should always be a cooling water flow through the reserve condenser.

The first Swedish power reactor, R3/Adam, is not expected to become economically competitive. It will, however, give valuable experience for future reactors of the heavy-water type and is thus an important step in the development of power stations for electricity production only, and particularly for the next step in the Swedish program, R4/Eva.

R4/Eva

The other project for which funds have been appropriated has been called Eva and will be purely for the generation of electricity. It will be located in central Sweden and have a capacity of 100 Mw (e). This plant, which will be basically the same type as R3/Adam, is expected to be ready for operation in 1967. The Eva power station will also be built by the State Power Board, with the Atomic Energy Company responsible for the design of the reactor. A group of private industrial concerns will undertake the construction and engineering work.

The Swedish power industry is considering the building of an additional nuclear power plant, based on an imported reactor, to be operated from 1965. The arguments in favor of this project are that it is desirable for the power industry to acquire experience from the construction and operation of such a plant as soon as possible, and before the R4/Eva can be completed; in

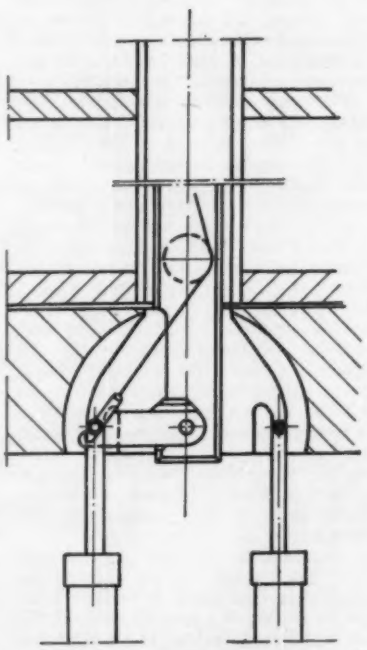

Fig. 4. Fuel element suspension and manipulator

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addition, the Swedish fund of experience will be widened considerably through the choice of another type concurrently with R4/Eva. However, no definite decision in the matter has yet been taken; limited resources of technical personnel are the main reason for very careful consideration before a new system is introduced parallel to the natural uranium heavy-water type.

Special Characteristics of the Swedish Program

Harry Brynielsson, head of the Swedish Atomic Energy Company, has pointed out that three factors largely determine the Swedish reactor program. They are (a) the energy situation in Sweden and the ever-increasing import of fuels; (b) the existence of nuclear fuels in Sweden; and (c) the technical, scientific and industrial resources of the country.

The nature of the energy situation has already been indicated. As regards the nuclear fuel resources, it may be pointed out that the large deposits of shales in central Sweden contain uranium, and a small extraction plant has been in operation since 1953. The present output is approximately 10 tons per year. A bigger plant with an estimated annual output of 120 tons is under construction. It is planned to be in operation by 1964 and should be able to meet Swedish needs in the 1960's. One of the main reasons for having the present Swedish reactor program based on natural uranium is of course the existence of this material in the country. The refining of uranium concentrate and the manufacture of fuel elements is being done by the Atomic Energy Company in Stockholm.

The research work is mainly carried out at the new research center of the Atomic Energy Company, Studsvik. A materials testing reactor, a zero energy reactor and exponential assemblies, together with the necessary supporting facilities, are used in the development of the Swedish power reactor systems. An extensive research program is also being carried out for the production of nuclear materials, like heavy water, and the processing of spent nuclear fuel.

A further special characteristic of the Swedish program is the very close collaboration among the State, municipal authorities and private industry — an association which is reflected in the organization of the Swedish Atomic Energy Company and the implementation of the first projects.

The Swedish reactor program has so far followed a strictly national line, centered round the natural uranium, heavy-water reactor type, but development abroad is followed closely. Sweden can hardly afford to develop a variety of reactor types, and the available opportunities for collaboration in international program have therefore been taken, as for instance in the OEEC projects concerning the boiling heavy-water reactor at Halden, Norway, and the high-temperature, gas-cooled reactor at Winfrith Heath, in the United Kingdom. THE END

Progress Report on Dresden

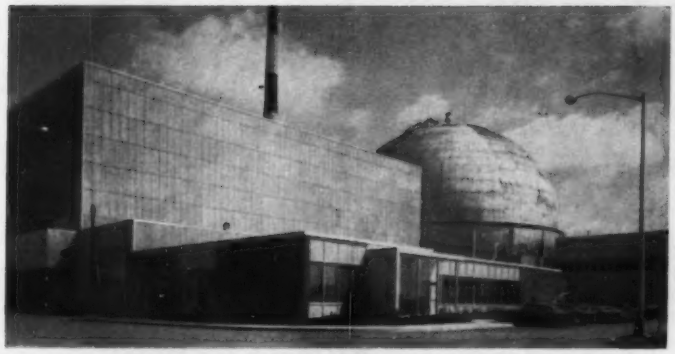

Fig. 1. Dresden Nuclear Station, located some 50 miles from Chicago, produced its first electricity for the Commonwealth Edison network on April 15, 1960

Fig. 2. One of the last steps before producing steam for the first production of electricity came when technicians placed the 50-ton head on the reactor

DRESDEN STATION, the 180,000 kw(e) nuclear power plant of the Commonwealth Edison Company, began full power operation on June 30. This represents the final phase of a period of testing and gradual approach to power operation that began when the reactor first achieved criticality on October 15, 1959.

On that date criticality was reached with a fuel loading of 28 fuel-element assemblies. When fully loaded, the Dresden core will have a total of 488 such assemblies. After completion of the tests with the 28 fuel elements, core loading was continued to the "twice minimum critical" point (54 fuel assemblies were required for the "twice minimum critical"). Tests at this level were completed by early November.

Following these tests, while more fuel was being loaded, the instrumentation indicated that when three of the control rod drives were operated, there was no apparent effect on the reactivity of the reactor. Critical loading and testing were immediately stopped, and an investigation of the problem begun. Investigation revealed that the poison blade had become disconnected from the drive mechanism on these rods be-

Fig. 3. The 180,000-kw turbine generator unit at Dresden Station. This is the first large generating unit in the world to be powered by steam from a boiling-water reactor

cause of shearing of the shear pins. As a consequence, when the drive mechanism was manipulated the control rods remained in the core.

Two principal causes of this shearing were found after extensive testing at Dresden and at the General Electric Atomic Power Equipment Department (APED) at San Jose, California. One of these was loss of buffering action at the end of the scram strokes because of damaged seal rings. The other was from too rapid deceleration of the rod as it entered the buffering region.

All of the damaged seals were immediately replaced, modifications were made to the hydraulic system, and clearances of connecting linkages were modified to correct the trouble. Rigorous tests equivalent to several years of operation were performed on all drive mechanisms, and no further evidence of trouble was noted.

Fuel loading was then continued to the next planned step of 256 elements on February 11, 1960. Everything went well during this loading stage, and after successful testing, loading was continued to 320 elements. Nuclear testing with 320 elements in the core was completed on March 4, and loading to the next level, 350, was commenced. Then, from March 4 to March 14 tests were conducted with configurations of 350, 362, 376, 400, 424, and finally at 448.

After completing nuclear tests with 448 elements in the core, the permanent nuclear start-up sources and turning vane were installed in the reactor. System flushing, hydrostatic testing and other preparatory work was also started at this time.

The critical testing period for large power plants is extensive and time consuming, but since Dresden is the first large boiling-water reactor plant, it is desirable to proceed slowly in order to learn everything possible from the preliminary tests. Among other things in the operation of a nuclear power plant, it is necessary to be certain that the steam and water systems contain no foreign matter of any kind. At Dresden, the system was thoroughly flushed out with steam produced by two Keeler Type-DK package steam generators. The two 55,000-lb/hr units were fired up without removing them from the railroad flat cars on which they had traveled from the manufacturing plant. The units were operated at capacities up to 68,000 lb/hr for considerable periods in the preliminary checking and later final checking of the plant's steam system, and balancing of the turbine rotor.

The first power from Dresden was fed into the Commonwealth Edison interconnected system on April 15, 1960, as the steam supply system reached 16 electrical megawatts on single-cycle operation. Dresden is, of course, designed for dual-cycle operation, but this preliminary operation was on single cycle. On April 18, the plant was producing 65 Mw(e), and the thermal output was approximately 230 Mw.

Following this initial power operation, the system was gradually brought up to half-power, 315 Mw(t) and then shut down for various checks. This half-power operation brought the reactor up to the limit provided by the AEC license in effect at that time.

Until the end of March all criticality tests were made with the reactor vessel open. On March 31, however, the reactor vessel head was installed and the first nuclear heating was attained. This was followed by a series of minimum power level tests ranging from zero to full temperature and pressure. The system was heated to 542 F at 1000 psi. The temperature coefficients were found to be negative at all measured power levels.

After operation at half-power level, the reactor was shut down and the head removed. At this time the flux distribution was determined by scanning the complete core and each rod of one special fuel assembly.

By early May, the Dresden station had completed its initial power production run on both single and dual cycle. During this period, the station produced nearly 25 million kilowatthours for the Commonwealth Edison system. Maximum electrical power reached was 90 Mw.

This run, of course, was all a part of the extensive start-up program of the station, designed to develop all of the information necessary to check design and performance calculations for the plant. The data gathered in this phase of the work formed the basis for the formal request to the AEC for a license to proceed to full power operation.

When the reactor vessel head was removed after the half-power run on May 1, 84 out of the 448 fuel elements were scanned. Results of this scan confirmed all calculations and pertinent test measurements for flux distribution. Based on the core scan, and accumulation of poisons, four additional elements were inserted in the core for the next stage of testing. The specially constructed disassembly element was entirely dismantled, and each of the 144 segments was scanned to determine flux distribution throughout the element. This procedure was carried out remotely in the fuel storage pool.

On June 2, 1960, the AEC issued a license to allow further testing and operation at rated power. The plant was again started up during the week of June 13 to complete the test program to full power operation. The approach from half to full power was made in 60-megawatt (thermal) steps as provided in the license. Following the operation to full power, additional performance tests will be conducted before sustained operation is begun.

During the present period, Dresden operators are receiving classroom training, discussing reactor operation with start-up personnel, and assisting in maintenance operations.

To date Dresden operation has generally been in accordance with calculated performance. Projections of the half-power test data give confidence of good performance at rated power. The control rod drive system, which exhibited the difficulties described above, after modification has operated in a reliable and consistent manner throughout the entire testing program. Radiation surveys at 315 Mw(t) indicated that the shielding is adequate for full power operation. It was also determined that no radiation hazards existed due to radiations in the off-

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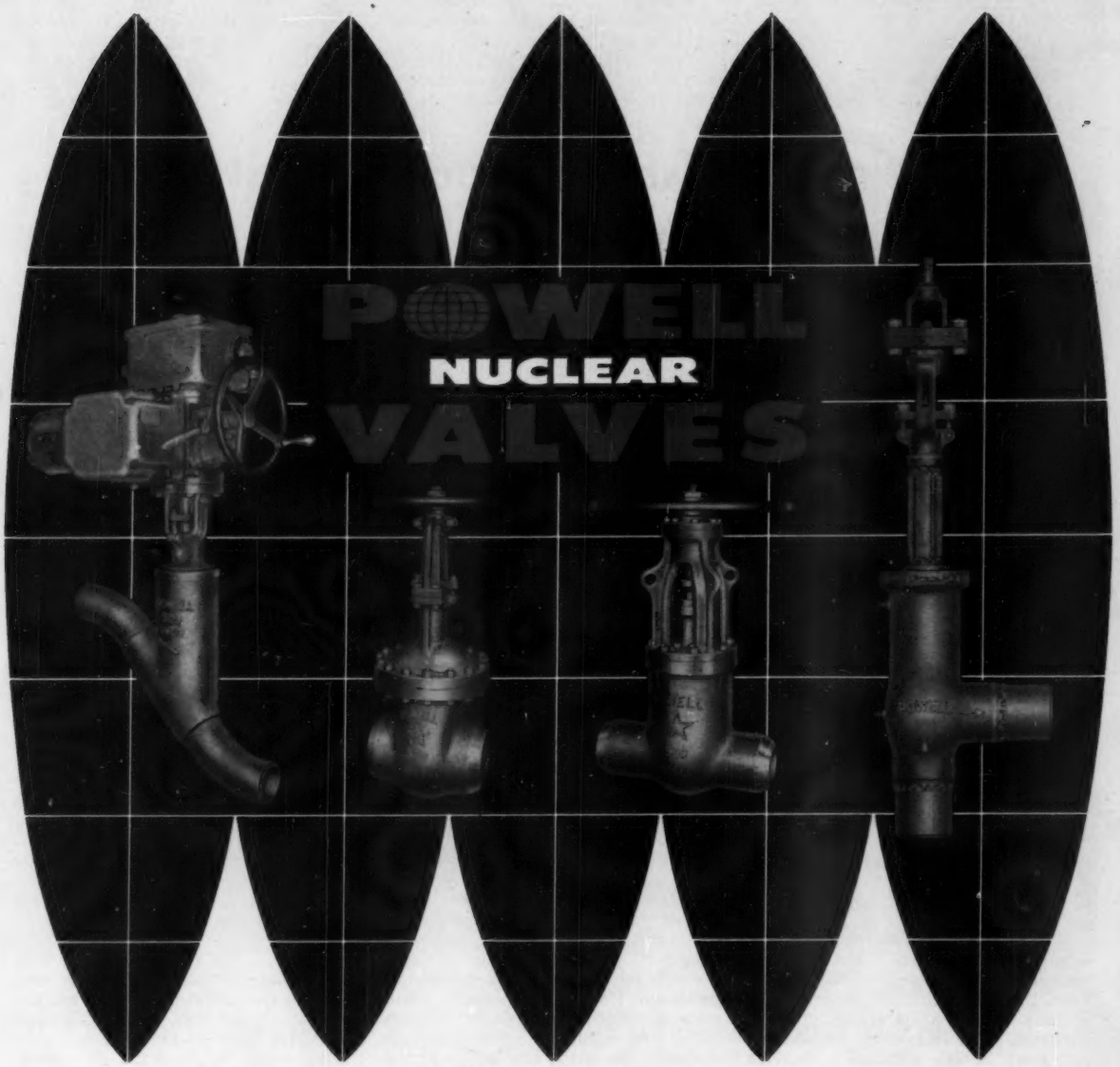

*4-inch steel Bell-O-Seal "Y" valve for 300 pounds pressure.

Fig. 3003 W. E.—Steel bolted bonnet gate valve for 300 pounds W. P. Bolted bonnet valves can be supplied for pressures from 150 through 2500 pounds.

Fig. 19003—Steel pressure seal gate valve for 900 pounds pressure. Also available in 600, 1500, 2500 pounds W.P.

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gas system or owing to buildup of radioactive contamination in the form of corrosion products or fission products in any of the areas surveyed. Off-gases have been monitored and they indicate that fission product release has been less than 100 microcuries per second, compared to license limitations of 700,000 microcuries per second.

Activation of the Dresden plant marks the initial electric production of the largest nuclear power station in service or under construction in the United States. It was constructed in record time. This summer it has gone into full power operation, after just a little more than three years since construction work was begun. General Electric Company, builder of the station, is carrying out the test operations and training Commonwealth Edison operators as the program proceeds. THE END

Thinking About Radioactivity?

By Robert G. Gallagher

Health Physicist
Liberty Mutual Insurance Company*

IN THE UNITED STATES, it is hard to find a segment of industry that isn't using atomic energy in the form of radiation-producing equipment or radioisotopes. Furthermore, new industrial applications are being investigated and discovered at a surprising rate. Today, there are nearly 2000 firms in the United States that are licensed to use artificial isotopes under the Atomic Energy Commission's Byproduct Materials Program. These firms are in the field because their managements believe, and are convinced, that radiation offers a better way to do certain jobs, or can be used as a tool to learn something new.

Finding the best application, however, is just one step in launching a successful program. You soon come up against questions of safety, insurance, employee and public relations, and a host of other problems. They can be knotty, but every management must know where it stands with regard to them before it can cash in on the benefits. Therefore, answer these questions first:

(1) How much radioactivity can can be used safely?

If modern radiation protection standards and procedures are met, there need be no limit to the amount of radioisotopes that can be used safely.

A necessary portion of any radiation program is the part that guarantees it be done safely. This is your first premise, and it is essential. What's more, a carefully planned program is an important foundation for your future expansion in this field. In many cases, an adequate radiological safety program includes radiation protection and radiation record systems, public information and medical controls as well as safety equipment. These things must not be considered as "additional" expenses.

(2) How will safety laws affect plans?

You should have no trouble if your radiological program has been planned properly before being put into operation. But, you should know what regulations exist and trends in legislation. Most states have enabling legislation and this merely gives officials broad authority to require certain minimum standards.

In your locality, there are undoubtedly many unsolved legal problems that might affect your activities in the atomic energy field. One is manufacturer's product liability. This affects the user's relations with the suppliers of instrumentation and equipment.

Workmen's compensation acts constitute another problem. Many present-day compensation laws do not offer protection for the employee who shows symptoms of radiation damage after expiration of the statute of limitations — in some areas as brief as six months after an accident. You may be subject to suit under common law under some circumstances.

(3) How will a radiation project affect insurance?

Obtaining adequate coverage for the operation of a radiation facility presents no real problem. Some well-managed radioisotope and radiation installations have been insured in the United States for years.

Your standard fire and marine physical property damage policies probably exclude damage from nuclear radiation or radioactive contamination. However, coverage for nuclear damage other than a nuclear reactor or the use of new or used fuel elements therefrom may be purchased for a moderate additional premium from your present insurance carrier. For a reactor or work with fuel elements, the insurance industry has made available a syndicate arrangement that will afford coverage up to a maximum of $65,000,000.

There is no exclusion under your workman's compensation and employee liability policy for nuclear injury to employees. Under certain circumstances, such as the operation of a reactor, your rates may be increased. As you may be subject to suit under common law, you should consider purchasing high limits under Coverage B, the common law provision of the policy.

The insurance industry has worked out a program whereby insurance for your liability for damage to the public, either bodily injury or damage to property, is covered under your liability policy or through a syndicate arrangement making available maximum liability limits of $60,000,000. Your liability policy as issued probably has an endorsement excluding certain areas of your nuclear energy hazard. However, the "normal" use of radioactive isotopes in industry is not excluded. This exclusion endorsement, and the need to purchase additional coverage from the syndicates, should be carefully reviewed in the light of the contemplated use of radioactive materials.

In assessing the coverage needed, management should recognize these five risks: (1) Damage to capital equipment, (2) Contamination of buildings, (3) Damage to product, (4) Injury to personnel and, (5) Damage to the public.

(4) What should you tell employees?

This is probably the most important problem for a firm starting to use radioactive materials and the one they are most likely to underestimate.

An education program is necessary to take the fear out of radiation work as well as to make certain that each employee knows and can stick to preplanned ground rules. He should know how to behave during routine radiation exposure and especially how to act under emergency conditions. One of the first things to learn is the significance of radiation warning symbols — how to evaluate the danger.

Actually, the program starts with management itself. The people who initiate the radiation project are the first to be sold on the benefits and reassured as to its potential hazards. They must be prepared to answer questions from people at lower work levels. They should not have to learn the facts as the result of a scare or a labor problem over the danger of radiation.

Your continuing education effort should be aimed at improving safety practices and increasing the radiation workers' knowledge of safety. This latter point is important because it's reasonable to expect that new applications for radiation will turn up in time, and there will be a need for informed and responsible workers to handle them.

(5) What should you tell the general public?

Be careful of how your community hears of your radioactive exposures.

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*Now Assistant Mgr., Biol. and Medicine, Nuclear Science & Engrg. Corp., Pittsburgh 36, Pa.

The "slave-hands" of an AI technician handle radioactive materials through a hot cell window 3½ feet thick. *Woodcut by Edward Kysar.*

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Much of AI's work has been on projects for the U.S. Atomic Energy Commission. This includes the Organic Moderated Reactor Experiment at the National Reactor Testing Station in Idaho and the Sodium Reactor Experiment in California. AI has also built and is operating SNAP II, a 220-pound prototype reactor designed to produce 3 KW of electricity for space vehicles.

With some of the most sophisticated facilities in the world at their disposal, the men at AI are now conducting studies for large power station reactors in the United States and Europe. Two reactors are now actually under construction under AEC programs—an Organic Moderated Reactor in Piqua, Ohio, and a Sodium Graphite Reactor in Hallam, Nebraska. Smaller research reactors have been built by Atomics International for Denmark, Germany, Italy, Japan, Puerto Rico and several sites in the U.S.A.

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Accurate news releases, guest speakers for town groups, plant tours and special reports to local technical societies are ways of informing the community. You must make it clear that your company fully understands the problem of protecting both the employees and the public.

(6) How are employees protected from radiation?

This is part of what is known as the field of "health-physics." It includes safety administration and organization, medical services, safety equipment and procedures, and related subjects. Now, how are the workers protected? Generally speaking, in three ways: (1) By limiting the time they are near the source, (2) By keeping a distance away from the source and, (3) By use of shielding such as lead or concrete to confine the radiation to areas that are useful.

One of the best ways to be certain that your plant is safe is to have a consultant check it periodically, perhaps every year. A qualified health-physics consultant may be able to bring you up to date on procedures, perhaps even eliminate unnecessary precautions. Besides, these checks offer reassurance to both management and employees.

(7) What special medical arrangements are needed?

Personnel monitoring, area radiation surveys, and air monitoring of radioactivity are necessary, but they cannot spot actual physical damage to a person. For this reason, if your plant is a large-scale user of radioactive materials, a competent physician should be retained to carry out the medical portion of the program.

For effectiveness, the physician should give a pre-employment medical examination to all prospective workers. Part of the purpose for these examinations is to spot individuals who are physically or emotionally unsuited to such work.

The doctor should have and receive the complete coöperation of supervisors, as well as the radiation safety officer, in determining the workers' continued suitability for radiation work. These examinations will help to reassure the workers about their physical condition and the risks. It will let them know that someone is personally interested in their welfare. Thus, the medical program serves as a final bulwark of protection for the employer as well as a benefit for the worker. THE END

New Nuclear Literature

Materials for Nuclear Reactors is the title of a new book recently published by McGraw-Hill Book Company, which brings together a great deal of information which has become available as a result of the AEC's declassification program but which has not found its way into the scientific and engineering journals. Under the editorship of Bernard Kopelman, formerly Chief Engineer of the Atomic Energy Division of Sylvania Electric Products, Inc, this book presents a systematic, comprehensive treatment of the atomic fuel cycle, and the preparation, properties, and behavior of the important materials in reactors. In thorough detail and with many illustrations, thirty specialists take the reader through the use cycle of uranium — from ore to the chemical reprocessing of irradiated, spent fuel elements. The book examines the properties — chemical, physical, and mechanical — of the many other materials that are found within a nuclear reactor, including their behavior under irradiation by nuclear particles. It is thus a bird's eye compendium of the advantages and of the limitations of materials as fuel elements, moderators, coolants, shields, and structure formers. The book ties together all the material and all of the processing steps that are combined to produce a fuel element, as well as presenting the over-all picture. Some of the topics covered include: uranium and thorium ores; their beneficiation, purification, and conversion to metals or oxide; their fabrication into several prominent types of fuel elements; the testing and evaluation of fuel elements; the stability or instability of the fuel to irradiation; and the chemical processing of the spent fuel to recover the unburned portion. Available at McGraw-Hill Book Co, Inc, 330 West 42nd St, New York, N. Y.; price $12. * * * In industry, as well as in areas of medicine and biology, more and more it is becoming necessary to know something about radioactive levels either in the environment or in the production of manufactured goods or in food processing, so a knowledge of at least some of the simpler types of radioactivity measuring devices becomes essential. Few people are aware that the measurement of radioactivity can be made with relatively simple equipment and at slight cost. Many of the instruments can be made in any ordinary laboratory or shop. The components required are now easily obtainable; also, little power is required for their operation so many of the instruments can be made fully portable. Anyone interested in learning something about the principles and design of radioactivity-measuring instruments, will be interested in a new book by that title recently published by the Philosophical Library. This little book (75 pages, 6 by 9 in., hard cloth binding) gives detailed instructions for making a number of the simpler radioactivity-measuring instruments with some idea of cost. The only requirements are an elementary knowledge of electricity and an ordinary measure of manual dexterity. M. C. Nokes, the author, was formerly Senior Science Master at Harrow School and is now working with the Isotope Division, Atomic Energy Research Establishment, Harwell, England. As Mr. Nokes points out, the introduction of halogen-quenched Geiger-Muller counter tubes has greatly simplified the problem of making measurements of radioactivity. It is now possible to use quite simple circuits using voltages of 400 or less. In addition, the quantity production of transistors has made possible a great saving in weight, and quite small portable counting rate meters can be made which are powered by small 3-

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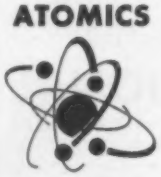

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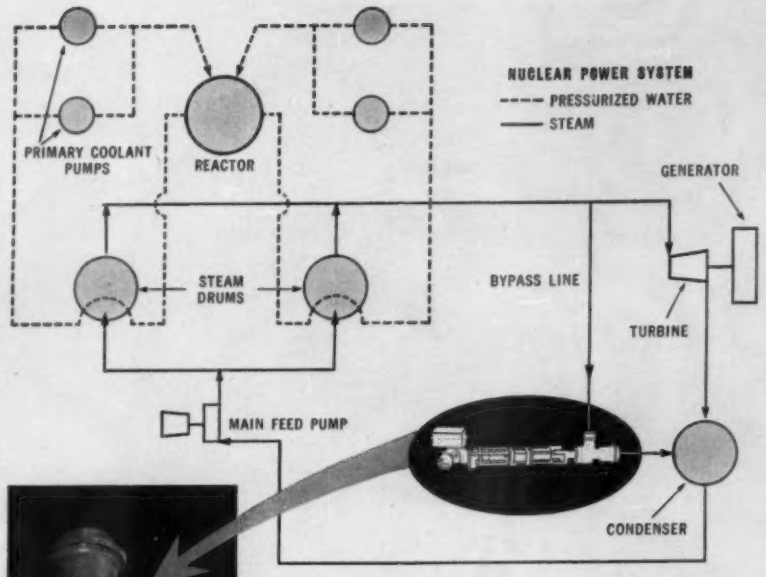
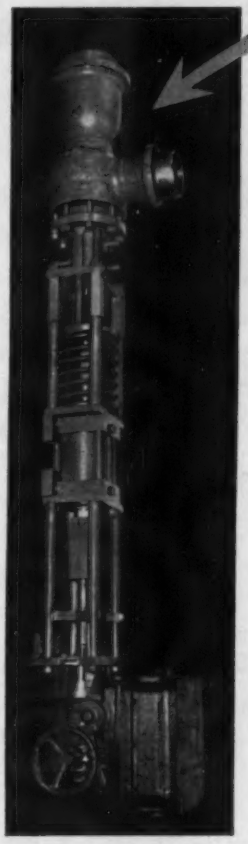
volt dry cells. Teachers should find this book valuable both in classroom and laboratory work. *Radioactivity Measuring Instruments — A Guide to their construction and use*, is available from the Philosophical Library, Inc, 15 East 40th St, New York, N. Y., at $4.75 per copy.

*** As reported in ATOMICS (Nov. 1958), the highlight of the 1958 Geneva Atoms-for-Peace Conference was the emphasis on the subject of controlled thermonuclear fusion. Thirteen, of the 44 countries that submitted papers at the conference, submitted papers dealing with systems for developing controlled thermonuclear power. In his opening speech, Dr. Perrin, the president of the 1958 Conference, referred to this emphasis on thermonuclear research at the conference as the main achievement in the complete elimination of secrecy in "this last outpost" of atomic energy. In addition to the many elaborate thermonuclear devices shown in actual operation, some 105 papers were submitted on this subject. These papers have been made available through the published proceedings of the Geneva Conference, but since they are scattered through many volumes, it is difficult to compare and analyze their content without spending an inordinate amount of time and effort in the process. It is, therefore, interesting to know that the essential data and information in the Geneva thermonuclear papers has now been distilled and concentrated into a single volume recently published by D. Van Nostrand Co, Inc. In this volume, in accordance with a carefully worked out plan, are presented the most significant ideas on fusion presented at the conference. This volume was edited by William P. Allis, Professor of Physics of Massachusetts Institute of Technology. As Dr. Allis points out in the preface, it was possible to arrange these 105 papers into groups of seven or eight each, and these groups constitute the eleven chapters of the book. The first chapter contains the survey papers, the next four discuss general plasma properties, then six chapters describe types of thermonuclear machines. It was necessary, however, in many cases to further cut the material of the selected papers so as to bring the total down to a volume of reasonable size. In the case of translations of foreign-language papers, changes were made for the sake of English idiom. All efforts were made not to alter the meaning of the orignal author. For those who are interested or concerned with the solid facts behind the dream of unlimited nuclear power, this book will have distinct appeal. The material in it comes directly from the scientists and engineers who are doing the work in this most fascinating field of research. *Nuclear Fusion* is published by D. Van Nostrand, Princeton, N. Y. It contains 488 pages and sells for $12.50.





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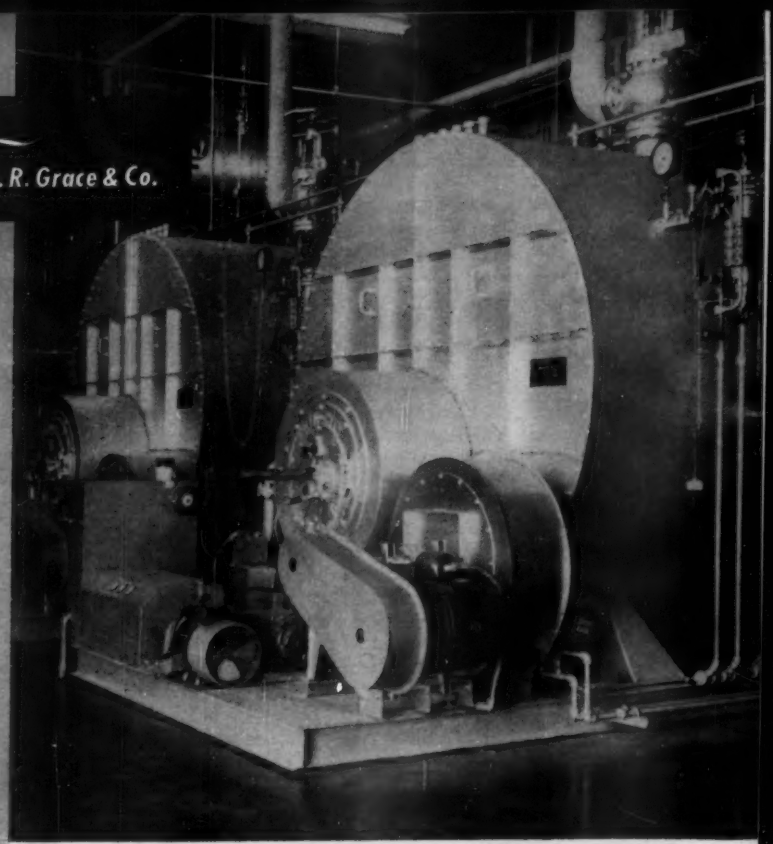

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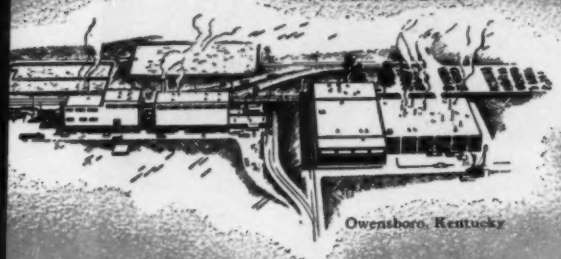

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A comprehensive report on the World Power Conference is presented in this issue. Editor Robert McCaw attended the sessions in Madrid, Spain in early June. Meeting's theme was to explore development of new and lower cost sources of energy, particularly for the under-developed countries of the world. Meeting highlights and areas of greater interest are presented in the next eight pages. 70

On June 30, it was announced that Commonwealth Edison's Dresden Nuclear Power Station had demonstrated full-power operation for the first time. Transmission lines relayed 180,000 kilowatts of electricity into nearby Chicago and northern Illinois. In the ATOMICS section, Editor Andrew Kramer traces developments and tests since October 15, 1959, when the reactor first achieved criticality. 59

The outside contractor is an important specialist whenever major repairs, alterations, or new construction are needed at a plant. Managements realize that it is better not to have to increase the size of their maintenance forces. They realize, too, that a potentially large savings can be gained by using their people who are truly experts at controlling the effectiveness of others. A professional maintenance planner discusses the control of these jobs. 80

The emblem adopted for the Meeting is composed of the sun of Spain and the windmills of Don Quixote, two power motives, one natural and primary, the other highly evocative, and both typical of Spain. The sun, source of life and power, is an essential element of the Spanish scene, brightening its fields and cities and bringing men and women to the Peninsula from all over the world.

IN MADRID, 2000 POWER ENGINEERS TACKLE WORLD ENERGY PROBLEMS

SECTIONAL MEETING OF THE WORLD POWER CONFERENCE DISCUSSES ENERGY SHORTAGES, REVIEWS NEW DEVELOPMENTS IN POWER PRODUCTION AND USE

POWER ENGINEERS from around the world, over 2000 strong, gathered in Madrid in June to attend the 1960 Sectional Meeting of the World Power Conference. Theme of this Conference was the development of new and lower-cost sources of energy, and particularly for the under-developed countries.

For the second time, Spain was host to this Conference, and did a splendid and gracious job. All sessions were held at the National Institute of Industry, which served extremely well both for meetings and a display of all Spanish industries. President of the World Power Conference is Dr. Franz Holzinger of Vienna.

The Madrid meeting was officially opened on June 6 by J. A. Suanzes, president of the Spanish National Committee of WPC, and also president of the National Institute of Industry. Following Mr. Suanzes' welcoming remarks, responses were given by the representatives from different countries. Francis L. Adams, of the Federal Power Commission, responded from the U. S. In another response, G. A. Mazza, of Argentina, expressed the gratitude of his country for having been readmitted to the Conference.

Other responses were given by W. H. Connolly of Australia, M. Combet of France, Sir Christopher Hinton of Great Britain, Mr. Nayar of India, M. P. Sevette of the United Nations, Dr. Franz Holzinger of Austria, and Jorge Vigon of Spain.

In contrast to the usual discussion of power problems in the U. S., the Conference gave considerable attention to the subject of energy sources in under-developed countries. Solar and windpower energy are becoming quite important to some areas where coal, oil and gas are scarce.

France has a peculiar situation, in that over-development of potential hydro capacity might well upset the national coal-mining industry, as far as labor is concerned. France looks forward to natural gas from the Middle East, because the country is up to capacity on local reserves of this fuel. This applies to heat for industrial and residential uses.

Dr. Frank Pittman of the Atomic Energy Commission gave an excellent lecture on the future plans for nuclear energy development of the U. S. Atomic Energy Commission.

American Electric Power Co's Philip Sporn discussed developments of high-temperature thermal plants. He stated that increases in temperatures (and efficiencies) are presently limited by materials for piping.

Considerable interest was shown in bulb-type turbines. Nuclear plants for central heating are of considerable interest to Sweden.

On the subject of extra high voltage, A. B. Perez stated that construction costs make the use of 500 kv only slightly more advantageous than 380 kv. There was some discussion on the best possible standard voltage for a European grid system.

K. E. Hapgood, TVA, discussed the short test section of a 460-kv line they are building in the U. S. This section will be part of a standard line, designed for 161-kv service.

Dr. Abetti of General Electric reported on the progress of the EHV project in New England. Johnson, also of GE, reported on a study of underground d-c cable construction versus conventional overhead a-c type. Conclusion was that a line of more than 40 miles is required to make dc comparative to ac.

On the subject of load-growth pre-

dictions, Francis Adams showed evidence that neither population increase nor gross national product are reliable yardsticks.

For new installations in Spain it is believed that hydro plants will continue to predominate for the immediate future, though a certain proportion of thermal stations will always be required because of great irregularity in river flow. In Europe, the development of production of electricity tends toward thermal energy. In the United States an even more marked tendency in this direction is evident.

All papers were prepared in advance. The following summary gives highlights of the experience presented and discussed.

Energy Sources

As indicated by the General Reporter, the papers were concerned specifically with methods of research and development of power sources involving solid, liquid, and gaseous fuels, but it is impossible to isolate fossil fuel problems from those which arise out of the development (or non-development) of other sources, since both kinds of power supply are completely dependent on one another. In his own country, Spain, the reporter said, the dependence was largely upon non-fossil fuel sources, namely, hydroelectric and atomic.

Hydro power is displacing solid fuels in some countries because of its availability, flexibility and relative cheapness; but in other countries, which have a highly variable rainfall, the maintenance of equilibrium between supply and demand requires the establishment of thermal power stations running on solid, liquid, or gaseous fuels, which increases the demand for these fuels. Many countries, however, are approaching the limits of their capacity to produce hydro power, and this means that the growing demand for power can be met only by drawing on new sources of energy or stepping up the production of conventional fuels.

For the group concerned with fossil fuels, the really serious problem is posed by nuclear energy. When and how far will atomic energy be able to replace that produced by burning fossil fuels? Will it eventually become available even for light transport? On these unknowns the future of fossil fuels largely depends; and, as the Reporter pointed out, there are other kinds of power, such as that from the sun, the tides, and the wind, about which the last word has not yet been said. Some of them, perhaps all, in due course, affect the interplay of factors destined to operate on the future demand for fossil fuels.

General conclusion to be drawn from all the papers on resources was their unanimity in stressing how important the evaluation of solid, liquid, and gaseous fuel reserves is for the future of every country.

Problems of liquid and gaseous fuels were dealt with from widely differing viewpoints. There were only two papers which stated the problem of countries that produce neither petroleum nor natural gas, and have to import them; these countries are Scotland and Portugal.

In the United States there is at present an excess of capacity in both production and refining, and large reserves of crude and manufactured products are stored. Reserves are evaluated on the basis of geological and geophysical explorations and by drilling.

Results and prospects of oil and natural gas research in West Germany, presented by Messrs. Bentz and Boigk, were instructive owing to the support which has been given to the use of scientific prospecting methods. The result was that at the end of the second World War, Germany had 23 oilfields in development, 18 of which are situated in the district north of Hanover, the richest area for hydrocarbons.

Efforts put forth by France in an attempt to overcome the unfavorable position of her energy balance, as regards hydrocarbons, have been remarkable and praiseworthy. The paper by Rutman and Vicart dealt with the production and marketing of natural gas, especially from the Lacq area.

By the end of 1960 it is expected the output from the Lacq area will reach 20 million m^3 (706.3 million cu ft) per day. The estimate of present reserve is 240,000 million m^3 (8.5 billion cu ft), with a recovery coefficient of 0.65, which gives recoverable reserves of 150,000 million m^3 (5.3 trillion cu ft).

Investigating Energy Needs

A large section of 19 papers dealt with the study and forecasting of energy needs on a national or regional basis.

The general and regional studies of electrical energy demand carried out in the U. S. by the Edison Electric Institute were seen as valuable and important, since data collected through close contact within consumer groups enable companies to make decisions based on knowledge of the business, and not on mathematical formulae, and to forecast needs.

Method used by Charbonnages de France to classify types of clients and coal, thus producing statistics which enable the coal situation in France to be appraised at a glance, was described in detail. Perforated filing cards are used which are returned regularly to the central office, and are the basis for a rapid and continuous compilation of statistics.

In talking about forecasting demands for electricity, the importance of economic factors was stressed, and the point was brought out that in handling economic factors bearing on energy, care must be taken to distinguish between structural and conjunctural economic factors. Errors in the evaluation of the relative importance of these have led, for instance, to a grave coal crisis in Germany and elsewhere in Europe.

Fig. 1. Francis L. Adams, Federal Power Commission, addresses Conference. Seated: Jorge Vigon, Spanish Minister of Public Works; J. A. Suanzes, president, Spanish National Committee; J. M. de Oriol; C. H. Gray, WPC's secretary; M. Golmayo; Dr. Franz Holzinger, WPC's president; J. Planell; H. A. Young; S. Soler; J. P. Pozuelo

Fig. 2. Covering meetings for POWER ENGINEERING, editor Robert F. McCaw chats with Gen. Itschner (right), Corps of Engineers' chief, and Mrs. McCaw

In Germany, forecasts of energy demand are based on an analysis of industrial sectors, with a preference for mathematical methods. Specific energy requirements of various economic activities and different industrial processes are studied. Installation of measuring devices is considered necessary for the success of these analyses.

Three Russian engineers stated that in the USSR, the fuel and power balance sheet is one of the major material balances in the present and long-term plans for the development of the country's economy. The following major trends are at present characteristic of the USSR energy balance sheet:

1. Large increase in the proved energy resources (coal, oil, natural gas), which insures high rates of development of the energy balance for a long time to come; 2. discovery in several areas of large and highly economical deposits of oil, gas and coal suitable for opencast production, which makes it possible to reduce development of output in the old, less economical coal-producing areas; 3. the new, highly economical areas of fuel production are located to the east or southeast of the basic fuel-consuming regions.

Significance of this last is that it has been proved in the USSR to be economical both to develop industries which are large consumers of power in such regions and to extend considerably the existing fuel and power connections, with the aim of directing fuel cargoes and power from the east westward.

Industrial development in Italy and the influence on it of the availability of energy was reviewed in one paper, while a second paper studied the relationship that exists in Italy between income increase and domestic consumption of electricity. Incomes are considerably higher in the north of Italy, but the rate of increase is higher in the south. These same trends are seen in the demand for energy for domestic uses.

In Spain, economic repercussions of electricity restrictions over the period 1944–57 can be valued at 59,000 million pesetas. This figure represents 14 per cent of the national and 40 per cent of the industrial income for 1957.

Constant betterment in the standard of living and increase in population bring about an increase in consumption of energy; increasing mechanization, automation and technical progress tend to stay this increase. Technical progress, which introduces better industrial processes, better mechanical and thermal efficiency, decrease of losses and better use of residual heat, contributes to a decrease in specific consumption. Consideration of these factors shows, however, that both absolute and specific consumption of energy will continue to increase.

Nuclear Power

Owing to its great significance in the world as a new source of energy, the problems of nuclear power resources and nuclear power development were considered in various papers all through the Conference.

Immediate objective is to procure reactors that will produce electric power able to compete with that obtained from conventional sources of energy in areas where the cost of fossil fuels is high. A balanced consideration of the pros and cons of this possibility seems to indicate that this goal will have been reached around 1970.

Papers presented by U. S. delegates indicated that the advanced concepts of converter reactors deserve special attention. It is estimated that they will be economical by 1968 in areas where the cost of conventional power is high and around 1975 in any region in the United States.

According to a report of the Atomic Power Development Corp, experience acquired in the construction of the Enrico Fermi Plant would seem to indicate that breeder reactors will be competitive around 1968, although for large unit capacities, 300 Mw(e).

Another point of greatest interest is the recycling of plutonium, which could make the reactors working with enriched fuel independent of the enrichment plants which are necessarily costly.

Another tendency, more marked even than in the case of conventional plants, is that of going to high unit capacities with the object of reducing the cost of the nuclear kwh produced.

Nuclear power is coming to the Philippines. Messrs Afable, Nuguid, and Wugenio presented a detailed study of energy problems in that country. Total installed capacity (1955) was 431 Mw, of which 175 Mw corresponded to thermal power stations, 186 Mw to hydroelectric stations, and 70 Mw to diesel plants.

In the introductory part of their paper, Hinton, Brown, and Rotherham of Britain pointed out that although the urgency for nuclear power facilities has somewhat subsided in Great Britain, on the other hand the long-term influence of investments in electric power generating plant, either of the conventional or nuclear type, requires a conjectural approach to their economic development in order that correct decisions may be made. With all the reservations to which the authors of the paper drew attention, they consider that in 1966 a nuclear power station could compete economically with a coal-fired plant

if its degree of utilization were higher than 75 per cent, and in 1970 if it were 60 per cent.

Of unusual significance was the paper by Drs. Zinn and Dietrich of the U. S. on a long-term study of nuclear power development. This paper stressed the undeniable fact that the world's nuclear energy reserves are conditioned by existing thorium and uranium deposits, and also by the more or less adequate use of nuclear fuels derived from them.

Fortunately, it appears that existing amounts are more than sufficient to meet any energy demand in the predictable future and that the ultimate theoretical limit of the energy produced by these fuels, as compared to that which must be employed in their extraction and preparation, is, as yet, extremely favorable, even taking into account the great dilution in the earth's crust. However, high-content uranium and thorium ores are few, those of medium content more abundant, while those containing small amounts of both these elements exist in enormous quantities.

The energy content of the U^{235} in natural uranium is about 5000 Mwd/t of uranium. If natural uranium derived from U_3O_8, whose extraction cost is $10 per lb, is used in a nuclear plant, and if energy equal to 5000 Mwd is obtained from each ton of uranium and is converted into electricity, then the $10 per lb extraction cost will make a contribution of about 0.6 mill/kwh to the cost of electricity. If, however, the energy produced from each ton could be multiplied by breeding, by a factor of, say, 50, then one could pay 50 times as much — or $500 per lb of U_3O_8 — for extraction of the fuel from its ore without exceeding a contribution of 0.6 mill/kwh for this cost.

Indices of investment in nuclear power stations are still high in relation to that of conventional installations, and even if the favorable counterpart of lower fuel cost opens the way for a possible over-all economic advantage, the condition of operating with very high load factors is indispensable for the time being, though not in every case, in order to become competitive with the conventional steam power stations.

In some countries, the expensiveness or scarcity of fuels, or even a lack of hydroelectric resources, has made it necessary to undertake the installation of nuclear power stations without delay, or at least to prepare studies and technical equipment in order to have them ready for installation of atomic plants in the near future.

Italy, for example, finds that 60 to 65 per cent of her hydroelectric reserves have already been exploited. While the hydro power in Italy is supplemented by geothermal power, the load growth has demanded increase in the capacity of conventional thermal stations. Thermal station power has risen from 9.8 per cent of the total in 1951 to 21 per cent in 1958. Consequently, the development of nuclear power is receiving considerable attention in Italy. The present program includes the establishment of three power stations totaling 500 Mw; one a pressurized-water reactor, another with a boiling-water reactor, and the third one with a gas-cooled, graphite-moderated reactor.

Interesting facts were brought out concerning India's power resources, in a paper by Messrs. Chakravarti and Srinivasan. Coal reserves there are relatively scarce, oil reserves are very small, and the hydro potential is estimated at 35 to 40 million kilowatts. It is foreseen that the installed power capacity will have to double within five or six years.

Known deposits of uranium and thorium in India are quite considerable, however, (500,000 tons and 30,000 tons respectively) and equivalent in energy value to 30 times the total reserves of coal. Thus nuclear energy radically changes the fuel resources picture of the country, and India is looking forward to the development of nuclear power with great interest.

Thermal Power Stations

E. C. Redal and F. M. Qués of Spain summarized the principal points brought out in the papers on efficiency in production and utilization of energy obtained from conventional fuels.

It seems generally agreed that coal, oil and gas will form the base of our fuel resources, using conventional fuels to the limit, exploiting inferior ones as possible. Lower-grade coals will yield many valuable industrial by-products.

Despite possessing abundance of high-grade coal, Belgium, C. Wilwertz said, provides a typical example of how to make efficient use of coal by-products such as fines and slurry with ash content of 40–50 per cent and moisture of 10–12 per cent, and shales from coal-mine reject dumps with a 60 to 70 per cent ash content dry.

In 1958, the average specific consumption of Belgian electricity-generating firms was 13,000 Btu per kwh useful; the proportion of the coal by-products mentioned above that was burnt was 60 per cent of the total fuel used, and the average calorific power was below 4110 kcal/kg.

The good results achieved are thought to be due to the adoption of boilers for pulverized coal and powdery or dry ash, and U-shaped or W-shaped flame.

In France, G. Bouttes reported, the power stations of Houllères du Bassin du Nord et du Pasde-Calais burn coals of very different qualities, even down to those with 42 per cent ash content. It is hoped to achieve economical combustion of bituminous coals with 45 and even 50 per cent ash content, but experiments with non-bituminous types do not encourage much hope of similar advances.

In Germany also, special efforts are being made to burn the poorest types of fuels by means of mixed or simultaneous combustion of two, three or four of them. Good progress has been made in the construction of

Fig. 3. Panel at one session includes three American experts: Francis Adams (FPC), K. Irwin of Philadelphia Electric Co, and Gail Hathaway of the World Bank

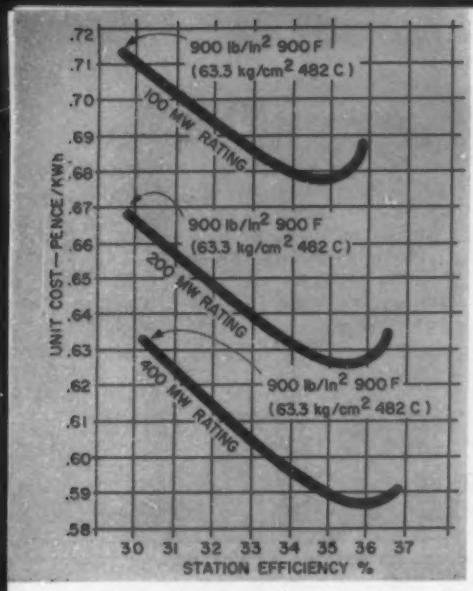


Fig. 4. Variation of cost per kwh with thermal efficiency and unit rating, as shown by E. S. Booth and J. W. H. Dore

special boilers for the economic use of such fuels.

Steam plant using poor quality solid fuels will provide the basic production of electrical energy in Czechoslovakia up to 1975 under the present plan. The better-quality fuels will be reserved for industrial uses. Production foreseen for 1975 will be: 56.3 per cent thermal, 7.28 per cent hydraulic, 1.59 per cent with gas turbines and 15.83 per cent by other unspecified means. Nuclear production will start in 1965 with a proportion of 1.5 per cent increasing to 1.6 per cent in 1970 and reaching 19 per cent in 1975. In 1960 the production by conventional thermal means will be 88 per cent of the total.

Zeman and Tintner reported on a Czechoslovakian cyclone furnace and described the advantages of preheating coal with a high ash content up to 1200 F in a heater specially designed for use with cyclone furnaces. This arrangement causes the coal to burn intensely and rapidly, reaching about 1800 C, and assures a perfect fusion of the ash, enabling the boiler's maximum capacity to be rapidly reached. Czechoslovakian boilers are designed with a worsening of fuel quality in mind, as the use of successively poorer qualities is planned.

Poland is also making great efforts to make use of her deposits of lignites and peat. The Polish plan for the production of electrical energy looks forward to meeting the increasing demand by the use of lignite up to 1965, and foresees that by 1975 greater use will be made of lignite than of bituminous coal for the production of electrical energy.

Italian thermal stations burn a wide range of fuels such as various coals, petroleum derivatives, natural gas and peat; and the general trend is to use boilers capable of simultaneous burning of different types of fuel, depending on availability and price. Boilers of nearly all modern plants in Italy are placed outside and there is a tendency to use monotubular boilers with forced and, in some cases, controlled circulation. Many of the modern Italian steam power stations are of very high unit capacity and designed to work for a considerable number of hours per year.

Five of the eight boilers in the Spanish station Compostilla I (167,000 kw) are of the traveling grate type and burn anthracite nuts with 7 per cent volatiles, 25 per cent ash and 10 to 12 per cent moisture content and a heat value less than 5250 kcal/kg. The other three boilers for pulverized coal and with ash fusion burn smalls, fines, mixtures and slurry.

At the moment the Compostilla II station is being fitted with a monobloc unit of 140,000 kw. Provision is made for the installation of three more units of the same type. Much the same sort of inferior-quality coals but with an even greater proportion of poor quality with higher ash content will be burned here, as in the Compostilla I station.

Increase of Efficiency

Some countries having ample resources of good-quality conventional fuels, and wishing to continue technical evolution uninterruptedly and to maintain low tariffs despite the increasing cost of plant and labor, are engaged in unceasing efforts to cut the costs of capital invested per installed kw of use and maintenance and specific consumption. Installation of units designed for supercritical steam conditions, the cost of which is high owing to the obligatory use of austenitic materials, has lowered the costs of specific consumption because the high costs of material are offset by the high efficiency of each plant.

In September of 1958 there were 26 turbines for steam temperatures of 595 C or more in use or in construction: 11 back-pressure ones of 25 to 285 t/h in Germany and 15 condensing, of which 11 are in the U. S., three in Germany (one of 80 Mw and two of 100 Mw) and one in Belgium of 115 Mw at 165 kg/cm² and 595/565 C (in the boiler 170 kg/cm² and 600/570 C).

The first 600-C back-pressure turbine in the world was put into service in 1951 in Leverkusen, Germany; and in April, 1959, it had been 53,000 hours in use. Shortly afterwards three units designed for 650 C were installed at the same station. These units continue to give completely satisfactory service after a brief running-in period.

It has been reported by the firms using them that, after two or three years' use, the first European 600-C condensing units have given no more trouble than their 530- and 540-C stations.

Progress in the development of high-alloy steels and efforts to reduce prices will determine whether these high temperatures will be generally adopted with consequent improvements in specific consumptions.

Increase in unit size has also contributed to higher efficiencies and reduction of costs per installed kw. It has been concluded in Great Britain that the construction of larger units is economical; that doubling the size results in a saving of 20 per cent in cost of installed kw; that an increase of 35 C in the initial steam temperature and in the reheating result in a 1.75 per cent improvement in thermal efficiency; and finally, that a 100 per cent increase in machine size with unchanged steam conditions results in a 1 per cent improvement in the thermal balance.

In the U. S., global installation costs of thermal stations have increased by slightly more than 200 per cent during the last 30 years. During the same period, however, thermal efficiency increased by 57.5 per cent. Cost of fuel consumed increased by only 26 per cent. Though fuel prices increased by 120 per cent, maintenance costs have not increased despite a 190 per cent rise in wages and a 92 per cent increase in the wholesale price of manufactured goods. Other production costs decreased by 38 per cent despite wage increases and, in general, production costs have been held stable over the 30-year period.

Improvements in efficiencies obtained in stand-by power stations, in peaking capacity and in industrial power stations are worthy of comment, and a paper from Italy studied some achievements.

Gas turbines fed with fuel oil are generally used in lower-capacity

plants used for stand-by and peaking; these plants, powered by 25-Mw units, take only 18 minutes to reach full load from cold. Efficiency is about 24 per cent. Yet, smaller plants are powered by 3500-kw gas turbines fed through free piston generators likewise using fuel oil.

One station is equipped with four diesel generator units, each designed for 2500 kw, besides back-pressure turbines. The generators are powered by natural-gas-operated, 4-stroke, 500-rpm, 16-cylinder engines. Heat from the cylinder cooling water is recovered and used to preheat the boiler feedwater to 40 C while the heat from the engine exhaust is recovered in heat-recovery boilers generating steam for the factory. Heat recovery is 11.5 per cent from engine exhaust and 12 per cent from cylinder cooling water. Over-all plant efficiency is 61.8 per cent.

Finally, there is the practical development of the mixed cycle of gas turbine and steam turbine, whose increase in thermal energy, great improvement in global efficiency, markedly better flexibility of use and smaller consumption at reduced load, give rise to great hopes. Experiments with this mixed cycle are continuing.

Peaking Power Plants

Use of outdated conventional thermal stations for peak shaving is recognized practice in countries with little or no hydro power resources. Likewise, use is made of plants involving low capital, operational and maintenance costs, even if their efficiency is relatively low. Yet a third possibility is the use of industrial stand-by stations if they can be spared at peak hours.

J. K. Dillard of the U. S. examined closely the most economic means of covering peak loads in systems in developmental or transformation stages. The papers refer to concrete cases in the U. S., but the investigation system is generally applicable to other cases.

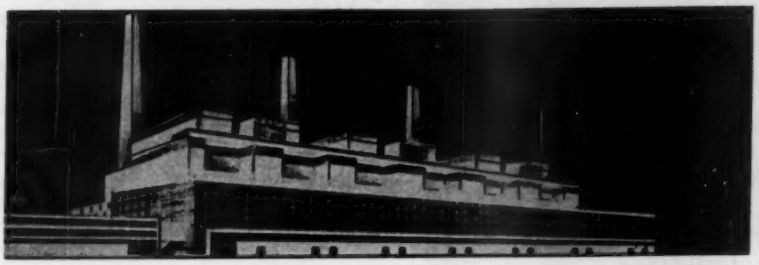


Fig. 5. Under construction in Poland, Turów power plant will produce 1200 Mw

Older, less efficient plants have been used to meet peak requirements while the base load was met by modern high-efficiency ones; but since improvements in thermal efficiency are becoming more and more limited and difficult to attain, this displacement of load to older units will cease to be an economical way of meeting peak demand. There are 365 gas-turbine units in sizes up to 25 Mw in stationary service at present in the world. Most of these are for industrial application and only two are specifically used for peaking service.

Dillard's conclusion is that, in the United States, the installation of peaking plant with a capacity of from 6 to 12 per cent is justified; that the higher the peaking capacity the lower must be the cost per installed kw; and that the lower the fuel costs the greater will be the usefulness of peaking plant.

Fuel Transport

A group of four papers, from Trinidad and Tobago, Italy, Spain and the USSR, studied the economics of fuel transport for power generation. Cheapest system is the transportation of crude oil by pipeline, provided there is sufficient capacity and distances are long, since the location of a power station plant and its capacity do not always justify the installation of a pipeline.

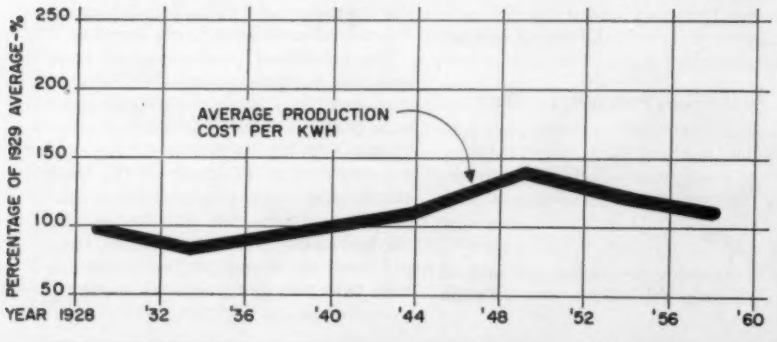
Of special interest was a comparison between the total costs of energy transmission by very high voltage lines and of fuel transport by rail. In many cases, the transportation of fuel by rail (coal of 7000 kcal/kg) is a more economical solution than the transmission of electric energy, even without taking into account the possibility of applying special rates in rail transport if the fuel is to travel on non-saturated lines. The authors of one paper even went so far as to state that not even 400-kv lines are able to compete with transportation by rail of any type of coal on lines handling more than 25 million tons per year.

Eight papers, from France, Canada, Japan, Great Britain, U. S., and Hungary, concentrated on progress in the methods of transport of conventional fuels. Taken all around, the papers clearly indicated the importance of fuel transport by pipeline.

General use is made of steel tubing complying with the American Petroleum Institute specification API 5LX-52 or equivalent, having a minimum creep limit of 3660 kg/cm² (52,000 psi) and minimum tensional resistance of 4650 kg/cm² (66,000 psi), which has made it possible to reduce thickness and hence weight per unit length by approximately 25 per cent, with resultant economy. Thinner pipe walls have also been partly made possible by the development of efficient anti-corrosion processes.

At present, pipelines of up to 36 in. in the United States and 30 in. in Canada are in use. In Europe,

Fig. 6. Production costs of American Electric Power, shown by Sporn and Fiala



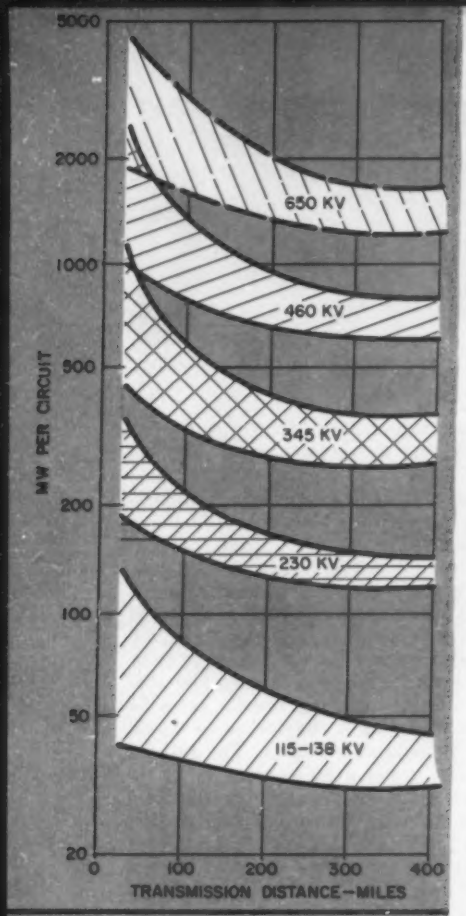


Fig. 7. Current economic transmission capabilities were presented by P. A. Abetti and I. B. Johnson of Project EHV

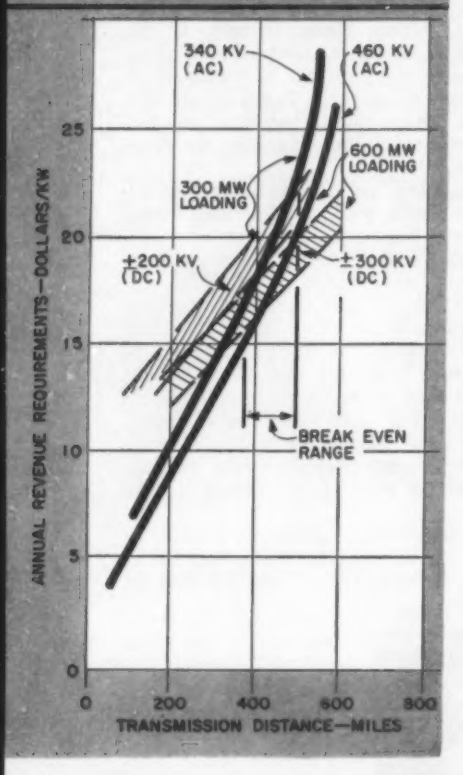


Fig. 8. Economic comparison of a-c and d-c transmission, Abetti and Johnson

pipes more than 40 in. in diameter are being manufactured with spiral welding, owing to the limitations imposed by the rolling of plates of suitable dimensions. For small-diameter piping, the use of aluminum is being introduced in the United States.

For the pumping of crude oil and other liquid fuels, centrifugal pumps are preferred, owing to their greater working flexibility. In gas transport, the tendency is towards centrifugal compressors arranged in series.

Cost of pipelines in the United States, in 1956, was reported to have averaged $3916 per inch diameter and per mile of piping, while the average construction costs of pumping stations in some relatively recent projects were of the order of $372 per bhp installed.

Transmission of Electricity

Constantly increasing demand for electrical energy has helped to develop transmission methods by raising voltages and integrating isolated networks by interconnections — in some cases even under the sea.

In Germany it seems uneconomic to contemplate a tension higher than 380 kv in view of the size of the present transmission loads. For the United States and Canada it appears that by using several circuits, a tension of 460 kv will be sufficient for the next ten or 20 years.

All studies indicate the tendency of the economic optimum towards higher transmission voltages; consequently 345-kv systems will continue to spread rapidly in the U. S. and Canada. During the 1960–1970 decade a further step-up to 460 or 500 kv will be introduced, and after 1970 one of the order of 690 is to be expected.

D-c transmission is in general not economically justified, though in some particular cases it may pay to use it, as in possible interconnections between grids separated by 500-mile distances, in which the use of 460 kv ac or dc is being studied.

Fuel From Petroleum, Gas

Use of petroleum products as fuel was discussed in four main applications: steel manufacture, cement manufacture, steam raising and gas-making. The needs of these industries together are a significant part of the energy requirements of the world.

Fuel oil is recognized as a most flexible fuel, which can be applied very easily in combination with other fuels. Attention was drawn, however, to its correct application, the use of well-designed burners, and the provision of installations correctly engineered so that the oil can be atomized efficiently and flame development can be positioned properly.

At WPC's Sectional meeting at Montreal in 1958, the first details were presented about Japanese investigations on the production of gas of high calorific value from coal with a high content of volatile matter. Final results, using a fluidized bed and a pressure of 5 kg/sq cm, shows a gasification efficiency of 75 per cent; the calorific value of the purified gas reaches 3960 kcal/cu m; the gasification rate is 830 kg/sq m/h; and 1.80 cu m of gas is produced per kg of dry coal with oxygen supply 0.49 cu m and steam supply 2.2 kg.

On interchangeability of combustible gases, there are some British opinions that the characteristics of the combustion could be defined by three parameters: calorific value, Wobbe number and speed of combustion. There are German proposals to use the calorific value, density and speed of combustion; and there are also Dutch tendencies toward the use of the Wobbe number and pressure control.

Hitherto it has not been possible to construct burners and other practical appliances combining all the conditions of interchangeability for the large family of fuel gases which are used at present. Hence, the classification of gases in groups, within which absolute interchangeability is possible, is most important.

An interesting proposal for standardization is being discussed in Holland, which will determine gases by the Wobbe number only, eliminating the influence of other parameters by the use of stabilized flame burners.

On combined production of heat and electricity, experience in Sweden was described where the back-pressure plant is used chiefly as a complement to hydro power during dry seasons and at the peak of the load curve. Although most of the back-pressure plants are not under the control of the power companies, they are none the less operated in such a way that the best national economy

is obtained. This is made possible by temporary power exchanges between power companies and the back-pressure plants, which limits back-pressure production during wet seasons and stimulates it during dry seasons.

Heat Plus Electricity

Poland has made extensive studies and developments involving the cooperation of industrial power plants with the grid. Development of the heat industry, based on utility heat and power stations, was initiated in Poland in 1952. Apart from its employment for heating of houses and public buildings, the heat industry plays an important part in the supplying of industrial plants. The principle has been accepted that heat must be supplied to the industrial plants by hot water pipe networks. But the existing installations call for many exceptions, since they are designed for heating by steam.

Czechoslovakia and Rumania have also made studies of long distance heating combined with power generation, and have concluded that such systems should be developed for economy of fuels and efficiency of operation.

Some interesting applications of waste heat from diesel and dual-fuel engines are being studied in Great Britain. Possibility of an absorption refrigeration plant driven by waste heat is examined from two different aspects: diesel charge air cooling for engine uprating, and production of cold for industrial applications and air conditioning. The application is being studied carefully, and alternative methods are described for distribution of the refrigeration effect and its influence on these engines. Another application being studied is the use of waste heat for desalination of salt water which requires considerable quantities of heat for a small return.

Hydro Power

A strong group of 18 papers concentrated on the general theme of efficiency in production and utilization of hydro power. The Conference was reminded that in exclusively or mainly hydro systems, the main operational problem to be solved is control of water consumption in reservoirs. In systems where thermal energy preponderates and no hydro surpluses occur, the object is to obtain an optimum outflow from reservoirs, so as to minimize operational expenses in a given period.

The hydro papers as a whole showed a strong interest in the application of rational exploitation methods that permit the maximum utilization of hydro power resources, the attainment of important economies and greater guarantee of sufficient production to meet demand.

Of interest were the satisfactory results claimed in a paper by S. Paes of Portugal, for the application of the law of load distribution to the Portuguese system which resulted in a relative efficiency approaching 99 per cent for the whole complex of stations during drought periods. Another paper, from Canada, described how the application of rationalized load coördination methods to the operation of various hydro and thermal plants resulted in savings of from $200 to $800 per day.

Various papers referred to the convenience of using computers to lighten the task of dealing with the large amount of statistical data indispensable for long-term exploitation methods.

D. L. Votruba and J. Tvaruzek of Czechoslovakia dealt with problems of daily peak loads in that country, which is relatively well provided with solid fuels but has only limited hydro resources and which, for this reason, places more importance on thermal production.

Steam condensing turbines are considered suitable for varied load demands; this applies particularly to those constructed in recent years because the time necessary for reaching maximum load from start has been considerably reduced, being in some cases reduced to less than one hour. However, the ever-decreasing consumption of new turbines makes it economically attractive to place them in the lower part of the daily load diagram immediately above the zone corresponding to run-of-river hydro stations or back-pressure turbines. The production of older thermal plant will consequently be placed higher on the diagram.

Four papers from Switzerland, Poland, and Germany indicated the great interest that is being taken in pumped storage plant, especially in those countries where thermal power provides the basic production of energy, or where a high percentage of hydro power is supplied from run-of-river plant and where the maximum use must be made of level rivers and no possibility of the establishment of annual regulation reservoirs exists.

According to experience in Germany, a pumped-storage station is usually an economic proposition if the cost per kw does not exceed 1.3 to 1.4 times the cost per kw of a thermal power station. THE END

Fig. 9. Francis Adams responding to Madrid's welcome to the U. S. delegation

About the WPC

In 1924, the first World Power Conference was held in England and was attended by over 1000 delegates from 43 countries.

Second conference followed, in Berlin, in 1930 — attended by 3900 members. In later years, the third meeting was held in Washington, D. C. in 1936; the fourth session in London (1950); and the fifth conference was in Vienna in 1956.

Australia will be host to the sixth World Power Conference, in 1962. Theme of that meeting will be "The Changing Pattern of Power."

In addition to the regular conferences, sectional meetings have been held in other years, from 1926 to 1958. These pertained to specific subjects in the power field, such as Fuels, Water Power and Planning.

Conferences are organized by the National Committee of the host country (often acting through a special Organizing Committee).

madrid 1960
conferencia mundial de la energia

WORLD POWER CONFERENCE 1960

HOW WE REPAIR CAVITATION DAMAGE ON HYDRO TURBINE RUNNERS

MARTIN FRIEDMANN, JR., WELDING SPECIALIST, TELLS HOW HIS ORGANIZATION APPLIES STAINLESS STEEL INLAYS TO CAVITATED RUNNERS, WITH THE RUNNERS IN PLACE

HYDRO TURBINES, under normal load, are not affected too much by cavitation. But, under reduced load — or overload — excessive turbulence causes cavitation. This leads to vibration, and, eventually, to major damage of the blades and loss of power. Vibration also may cause cavitation. All hydro plant operators are aware of this, and make periodic inspections. When the amount of cavitation becomes excessive, repair is made by gouging out the cavitated areas and welding an inlay of stainless steel.

The author and his organization have specialized in such repairs of runners by the stainless steel inlay welding process, and this article tells briefly how we do it.

Important time-saving and cost-saving aspect of our work is that, in most cases, we do this repair welding work with the runner in place — that is, without taking it out of the setting.

This involves some very special operations and an unusually able crew of men. The welders must work up on the spaces between the blades, in very cramped quarters, and carry out the operations described below. Because of these cramped quarters and poor lighting, it is very difficult to get good pictures to show how the men do it. As much as 80 per cent of the welding is vertical or overhead.

Accordingly, we can only show, in the accompanying photos, runner blades out of some wheels with the welded inlays on them, to show the principle of the process. These pictures are all from Newport News Shipbuilding and Dry Dock Co.

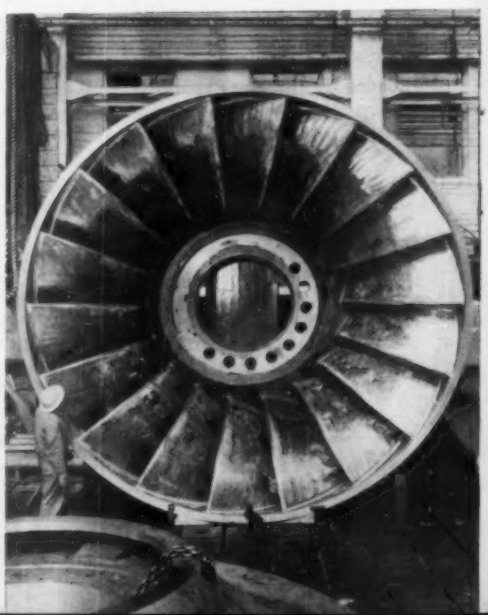
Some of these damaged runners weigh over 200 tons, and the amount of stainless inlay can amount to as much as 3000 lb. Time is an important factor. A large turbine generates a lot of power each day. Obviously, its down-time should be kept to a minimum. Many of our turbine repair jobs carry a $250 per day penalty, if not finished in the specified time. This may seem high, but if you consider the cost to the power company in lost production, this is a penalty they never want to impose.

Scheduling Repair Work

Repair work on these runners is usually done on a two-shift basis (for the shorter jobs, up to 30 days). On longer jobs it is on 3 shifts, 7 days per week. Of course, it depends largely on the amount of cavitation needing inlay, and the amount of time allowed us to complete the job.

This type of work requires much weld preparation; then welding, grinding and finishing to contour. The work demands men of experience and integrity. Expert turbine welders are required for this work.

Fig. 1. This shows the type of Francis turbine runner on which stainless steel inlay is used to repair cavitation damage. It happens to be a runner for one of the 250,000-hp units manufactured for the Niagara plant by Newport News Shipbuilding & Dry Dock Co. It is one of the largest in the U. S.



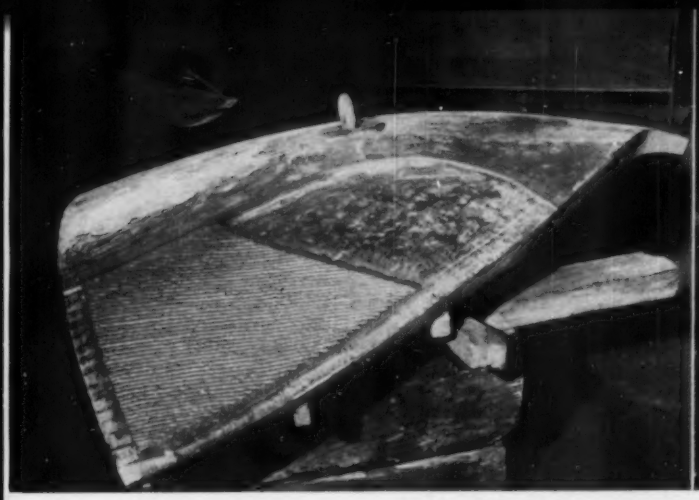


Fig. 2. Hydro turbine runner blade, showing how cavitation area is outlined, cavitation damage gouged out, and weld beads of stainless steel laid into it. Fig. 3. Runner blade with stainless steel welded inlay partially completed

In this type of work, the job site is usually in some very rugged country. Getting together a crew of men who can work together, deep under the mass of the dam, and often under poor living conditions, has presented its own problems.

Preparation

To prepare a turbine for welding, a pattern is made of the cavitated area, and usually the irregular edges are squared up to a uniform outline. Then the metal is gouged out to a depth of $\frac{1}{8}$ to $\frac{3}{16}$ in. all around the edges; next, a series of grooves (of uniform depth), approximately $\frac{3}{4}$ in. apart, is run all through the outlined area. After checking the depth of these grooves, the metal between them is cut away.

Chiseling or Arc-Air torch can be used; the torch is fastest, but the operator must be one who knows enough not to overheat, or serious warpage can occur. The reason the grooves are cut first is that it is the best way to insure keeping the original contour of the blade.

Welding is done in almost the same sequence. A series of beads is run in a pattern, $\frac{3}{4}$ in. apart, usually two (2) high. These are checked for height, and then the space between is filled. (If this procedure is not followed, there is a tendency to get flat spots.)

The welders must be artists, for stainless steel is not the easiest metal to grind. We use specially made wheels, plugs and discs with various grits, bonds and degrees of hardness. The best grinder is a 6- or 8-in., 5000-rpm grinder, 18 to 24 in. long, for the rough work. For the close places, and finish surface, disc (and offset) grinders are used.

Even on a small turbine we usually send 50 per cent more grinding equipment on the job than is actually needed, because of the difficulty of getting repairs on air tools in remote areas. We also carry some minor repair parts with us.

Welding rod is stored in sealed boxes, and the day's supply of rod is drawn from a hot box which is thermostatically controlled to 150 F. The high humidity of the places we work in requires this. We have a special magnetic pencil, which is calibrated not to stick if the inlaid metal is over $\frac{1}{8}$ in. thick. This gives a quick check of the inlay depth.

Jobs vary from 1500 sq in. up. Some turbine repairs have required 8 welders (working 11 hours a day), and 8 grinders (working 11 hours a night), plus helpers and foreman. This crew averages 1000 sq in. per day. A set-up like this is possible only on jobs over 30,000 sq in.

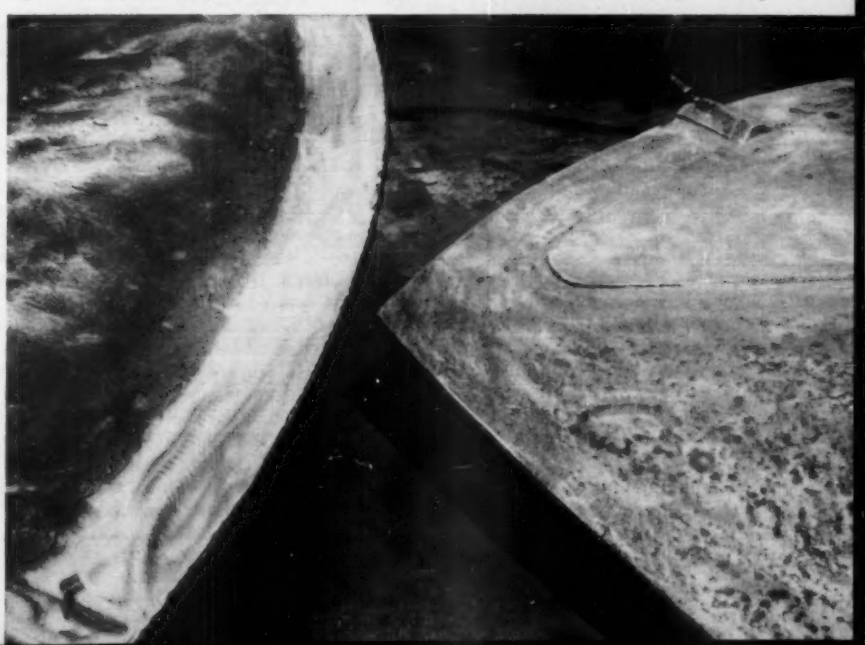
Some turbines, with blades close together, require a great amount of time; the larger ones are much easier. Francis-type wheels are the easiest to repair without warpage; Kaplan-type have to be very strictly controlled as to sequence and amount of welding. Exact formulas for this are not possible, as each wheel presents its own unique problems.

Prevention of Cavitation

For a number of years we have had a theory that cavitation can be reduced by cathodic protection. Latest investigations by a number of authorities seem to substantiate this theory. The most recent of these is a paper on Cathodic Protection Against Cavitation Damage, by Professor M. S. Plesset, of California Institute of Technology. His high-speed pictures of the cavitation phenomenon, run at 14.2 kilocycles (with, and without, impressed current), confirm our previously-published statement that cavitation can be reduced by using cathodic protection.

THE END

Fig. 4, At left, inlay ground to shape; right, runner blades before inlay welding



ACHIEVE HIGH EFFICIENCY, LOW COSTS

HOW TO CONTROL POWER JOBS DONE BY OUTSIDE CONTRACTOR

BERT CARSON OF HUDSON P. AND P CORP. TELLS HOW TO PROPERLY COORDINATE POWER CONTRACT WORK

RECOGNIZED ADVANTAGES in using outside specialist contractors for major repairs, alterations, and new construction far outweigh the disadvantages. The biggest single advantage is in not having to increase the size of the plant maintenance force for peak demands.

However, it must be remembered that the average outside contractor usually has to bring an unorganized crew to do the work. The contractor doesn't keep a large force of skilled labor on the payroll waiting for a job to break. When a big job comes, the contractor starts with his skeleton crew of supervisors and builds a construction unit around them.

Many of these men have never worked for the firm. There are those who have never worked together on a big job; hence, most contractors bring a crew of people who are not familiar with the same policies, working habits, or supervision. This is one of the main reasons the outside contractor usually insists on a cost-plus, rather than a fixed-fee, contract.

Actually, most managements realize this condition exists when the contract is let, and they are willing to put their confidence in the ability of the contractor to control these people. This the contractor can do to a degree, since most have capable construction engineers and supervisors. However, we must recognize that it takes more to control the effectiveness of people than a thorough knowledge of the work to be done.

A large portion of industry is well organized. Many plants have a first-class maintenance control department, consisting of a well-trained, well-organized staff. There is a good chance that these people can take on the additional duties of controlling the contract jobs, with the addition of a temporary typist. The systems have already been set up, and the people are trained in the operation. If management is to realize the savings that are possible by controlling contract jobs, procedures should be written, and policy adopted, for the letting of these contracts.

In writing the procedure, the writer must keep the full scope of the objective in mind and the steps necessary to bring about a closer relationship between engineering department, maintenance control department, and the contractor.

Comparing Bids

Prior to the issuance of invitations to bid, the company must be prepared to compare intelligently the bids when they are received. This can be done by: 1. Making an engineering study of the over-all project; 2. writing job orders for each phase; 3. making a list of all equipment and supplies necessary to complete the work; and 4. estimating labor hours required by construction trades — and cost of equipment and supplies. Finally, reduce man-hours of labor to dollars, and total all project labor.

These figures will be somewhat lower than the bidding contractors' bids, due to the fact that they do not allow for overhead expense. However, they will furnish a good comparison, and the power engineer will be more able to choose his contractor.

In many instances, letting the contract to the low bidder is not always wise, nor will it be the most economical in the long run. Bids submitted which are less than the owner's estimate should not be considered. Those within reason should be separated from the high ones and held for consideration. The reasonable bids should be considered on the basis of *price* — and *reputation of the contractor*.

A project engineer, assigned to represent the company, should work closely with the project cost controller in coördinating and controlling the project. The power engineer should make it clear that the power division's control department will coördinate the work and keep the cost of the project.

A meeting should be arranged with the contractor and plant personnel concerned. The cost controller should explain the method to be used for controlling the project. The contractor's supervisory force should be furnished with a step-by-step procedure. Regular meetings should be set up where the cost controller and the project engineer will schedule the work, talk over the progress being made, and compare the cost-to-date and per cent completion to the total capital appropriation. The power engineer should be kept informed, especially where unfavorable variances are apparent. The scheduling should be done by individual job order, using the contractor's estimates and the project engineer's step-by-step outline.

Written job orders (in the possession of the cost controller) should

be printed on a form, in accordance with the step-by-step outline. Space should be provided for the contractor to indicate, by job order, the trades of men, and total man-hours per trade. The cost controller will total the number of men, and man-hours, required by trade for the entire project, and secure from the project engineer the deadline for completion.

He will determine the number of working days involved from the start of the project until its desired completion. Using the estimated man-hours by trade, he will determine the size of crew needed by the contractor to meet the completion date.

Type of forms required for logging this information will be relatively simple. Below is a typical sheet.

While the cost controller is lining up the project, ready for scheduling, the project engineer should be making his final check on equipment and supplies. As the balance of the supplies comes in, the project engineer should notify the maintenance controller of the job orders which may be cleared for scheduling.

When invoices for the equipment and supplies arrive, they should be forwarded to the cost records clerk who will: 1. Secure the signature of the project engineer, denoting correct shipment and price per agreement; 2. post the costs to the individual equipment record cards by job order; and 3. forward the approved invoice to the accounting department for payment.

Each job order, with all cost identification codes (and a complete description of work to be done), should be typed on a duplicating master, designed for day-by-day scheduling. The trades required should be shown with number of men and total estimated hours. The *scheduling master* should be a bar-graph, or something similar. The cost controller, using the step-by-step outline, should indicate the day and hour for the start and completion of each job listed, coördinating the trades involved.

Contractor should be acquainted with the methods to be used in charging labor-hours and supplies used from the plant storeroom. The cost control department will furnish the contractor's crew with sample time cards and stores requisitions. Each of these forms must be accompanied by written instructions for their use. The contractor's supervisory personnel should be instructed in the proper method of filling out and approving these forms. At the end of each day, the contractor's supervisors will check time cards for clarity, correctness of charges, and deliver to the cost records clerk.

Cost records clerk will make a control total of hours charged against the project and will forward the cards to the data-processing section for costing and reporting.

Supply requisitions (and return-for-credit slips) should be processed daily by the stores records clerk. Items withdrawn will be posted from the requisitions to the stock records cards, and the cost price inserted on the requisition. These requisitions and return-for-credit slips will be forwarded to the maintenance records clerk. He will check all charges for correctness, make a control total of the amount, and forward to the data-processing section.

Data-processing section will perform five functions: 1. Punch detail cards for man-hours spent; 2. multiply the man-hours by the rate on each card; 3. punch detail cards for supply dollars; 4. sort both time and supply cards by job order; and 5. print the report, depicting job number, trade, and total of man-hours spent, and labor and supply cost.

This report will be printed for each day's transaction and delivered to the cost records clerk. He will have previously posted (to the equipment record card for each job) the estimated man-hours, labor cost, supplies, and totals. The cost clerk will post all charges to the equipment records, comparing the man-hours, and the labor and supply costs, with the total estimates. When the actual total reaches 80 per cent of the estimated, the records clerk will notify the cost controller, who will request the estimated per cent completion.

If this estimate is within five to eight per cent, there is no cause for alarm. If the variance is 10 per cent (or more) unfavorably, the project engineer should be notified. If corrective action will not alleviate the situation, the job should be re-estimated and the power engineer notified.

POWER DEPARTMENT WORK SCHEDULE

PAGE 1 PROJECT Replace #3 I.D. Fan DATE 8/9/1960

(* NOTE: "O"—OWNER; "C"—CONTRACTOR)

JOB NO.	DESCRIPTION OF WORK	* TRADE	NO. MEN	MAN-HOURS
101	Disconnect Drive Turbine	O-MTC.	2	4
101	Rebuild Drive Turbine	" "	2	46
102	Remove Turbine To Shop	C-Mill	4	16
103	Cut + Remove Breeching	C-M-W	4	

Records Files

All records files should be of the visible-index type. The equipment cards should be filed according to equipment-code number, as sub-cards to the over-all project card. As the individual jobs are completed, the man-hours and costs should be totaled and deducted from the total appropriation. By so doing, the total open capital appropriations is kept to a minimum, and management can tell the progress on the project.

The procedure for company-contractor relations should state clearly the company's policy of acceptance of completed contract jobs. The company representative should explain the policy before the contract is let, and receive a signed statement from the contractor to the effect that he agrees with this policy and understands there will be no exceptions.

Final settlement of the account should not be made until all tools and equipment — furnished by the owner — have been returned and accounted for.

When the company has been satisfied, the power engineer and the department superintendent should sign a statement of acceptance. The contractor should then receive final payment upon presentation of this document. THE END

Power Engineering

NEW DESUPERHEATER CONTROLS STEAM TEMPERATURE TO FUEL OIL HEATER

THIS REDUCES 1250-PSI. 950-F STATION STEAM TO KEEP FUEL OIL AT 335-350 F FOR BURNING AT BURLINGTON STATION. AS EXPLAINED BY T. J. FENEIS, ASST. ENGR., PSE & G

UNIQUE METHOD of desuperheating steam, for controlling fuel oil heater temperature, has recently been put in service at the Burlington Generating Station of Public Service Electric and Gas Co of New Jersey.

Decision to burn residual fuel in Nos. 11-15 boilers at Burlington required the utilization of as much of the existing fuel oil facilities as was feasible from the standpoint of operation and economics. Nature of the residual fuel, however, required the installation of three new fuel oil pumps with a total output of approximately 400 gpm, and a new heater of the shell-and-straight-tube design.

The heater raises the temperature of the residual fuel from 223 F to the required burning temperature of 335 F. Because of the high temperature heating requirements of the residual fuel, it was necessary to use the 1250-psi, 950-F station steam supply. To cope with this tough assignment, a single combination pressure-reducing and regulating valve, followed by the new variable-orifice desuperheater, was used.

Figure 1 shows the schematic control diagram of the pressure-reducing and desuperheating station. The reducing valve, which limits the upstream pressure to the heater at 650 psi, also controls the steam flow demand of the heater by means of a viscosity controller, which takes its impulse from an element in the oil discharge of the heater, controlling the viscosity of the fuel for burning. Condensate in the discharge of the flash tank is monitored by a fuel-oil leak detector that will sound an alarm if the drains become contaminated with oil. Thereupon, manually-operated valves will divert the drains to waste.

The variable-orifice desuperheater, as made by Copes-Vulcan Div of Blaw-Knox, shown in Fig. 4, is a relatively new approach to desuperheating problems for control of steam temperature. It consists of a section of steel pipe with a self-regulating orifice installed within. A weighted ball, the only moving part, is held in the orifice by Inconel springs. When there is no flow, the weighted ball seats itself in the self-regulating annular orifice; as flow develops, the incoming steam lifts the ball an amount determined by the weight of the ball and amount of steam flow. For each rate of flow, the ball takes a new position. The pressure drop is practically constant and is normally 3 to 4 psi for all flows.

Cooling water to the desuperheater

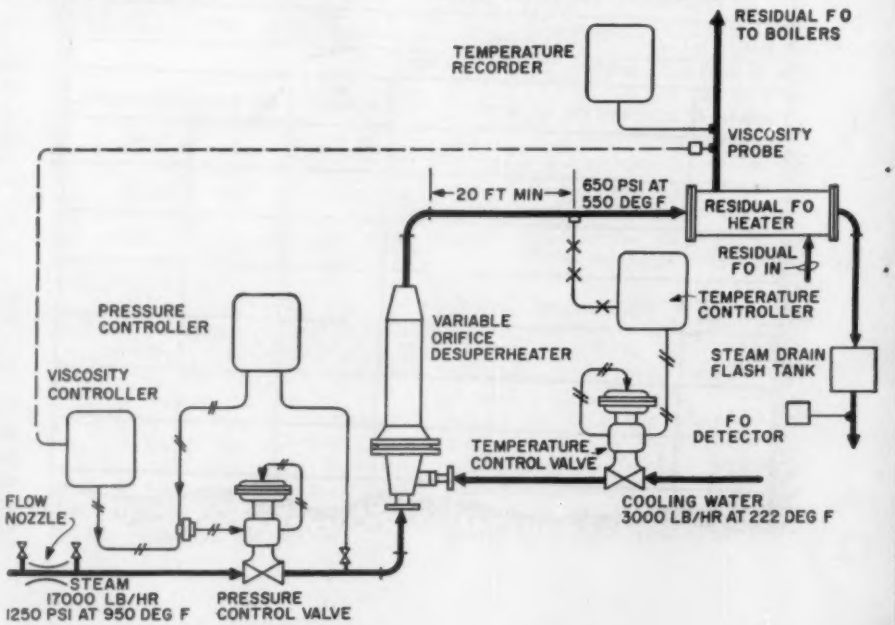


Fig. 1. Control diagram of desuperheating system for reducing h-p h-t steam to fuel oil heater at Burlington

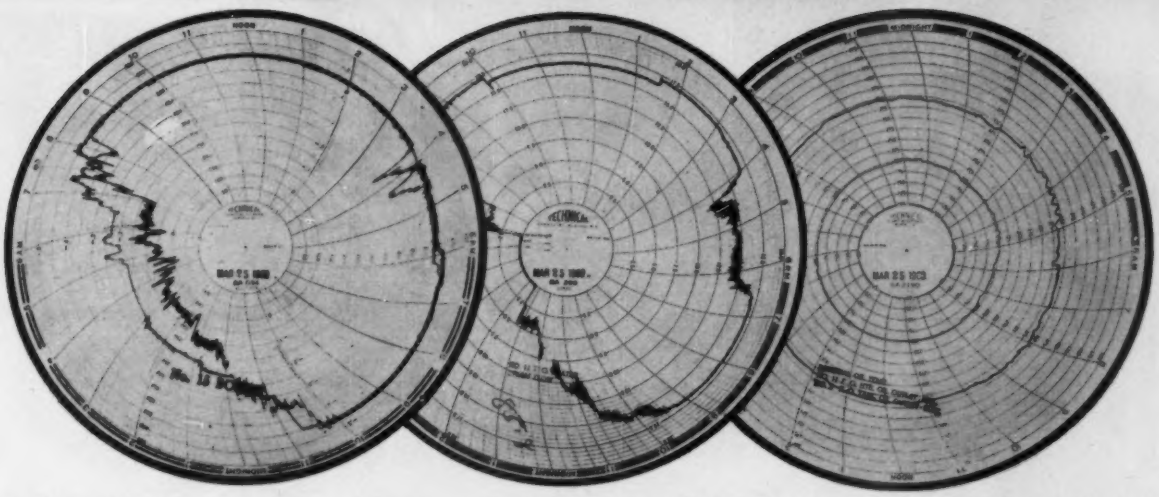


Fig. 2. Recorder charts showing performance on March 25, 1960, of desuperheating system for steam to oil heater

A. Steam flow from Boiler 15; boilers 11, 12, 13 and 14 are similar, but 11 took more load swings. **B.** Steam flow through desuperheater to fuel oil heater, approximately 17,000-lb-per-hr maximum flow. **C.** Inner chart record, temperature of residual fuel oil at tank outlet. Outer chart record, temperature of fuel oil at heater outlet

enters at the orifice seat, the point of highest pressure drop. With the ball held by the springs, the steam flows around the periphery of the ball in a uniform flow pattern. The water entering the orifice chamber comes in contact with the steam, making a continuous intimate mixture for complete vaporization.

The desuperheater is always installed in a vertical position. With steam flowing upward, any water not immediately absorbed remains in suspension within the desuperheater body. The amount of cooling water entering the desuperheater is controlled by a valve that takes its impulse from a temperature element located approximately 20 ft downstream of the desuperheater, as in Fig. 1.

The residual fuel system was put in service in September, 1958, and the desuperheater has been in continuous service for 18 months, as of March 25, 1960, with no down-time and no operating problems so far. Accompanying recorder charts show performance of the desuperheater for that typical operating day. THE END

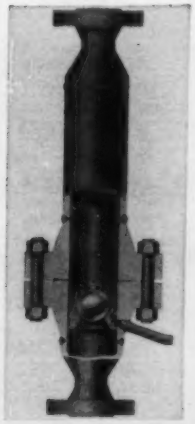
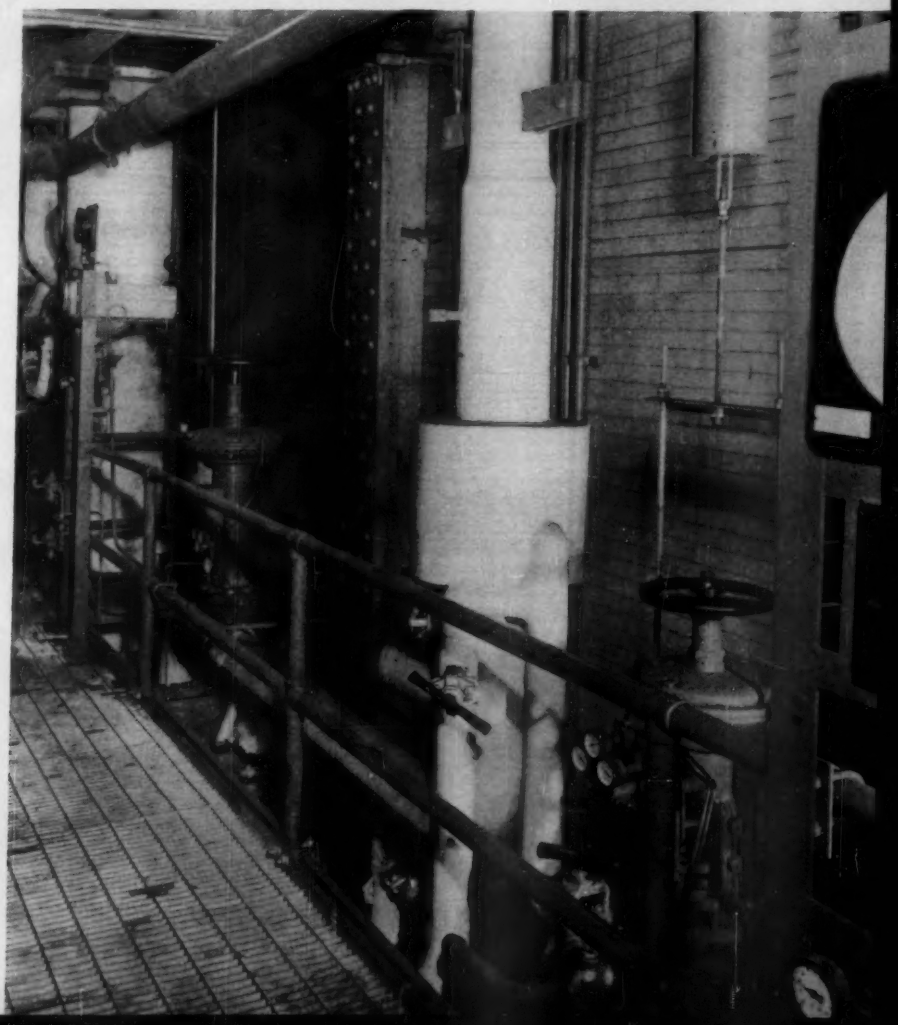
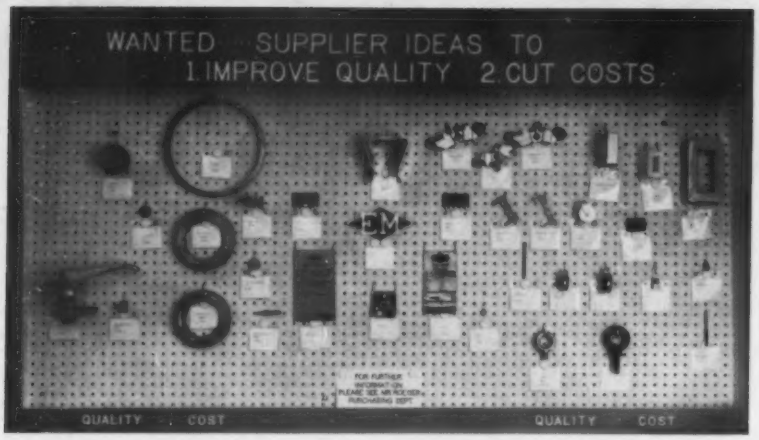


Fig. 4. Phantom view showing construction of variable-orifice desuperheater whose operation is explained in text

Fig. 3. View of variable orifice desuperheater and control valves, controlling fuel oil temperature, viscosity. Desuperheater is in insulated vertical pipe

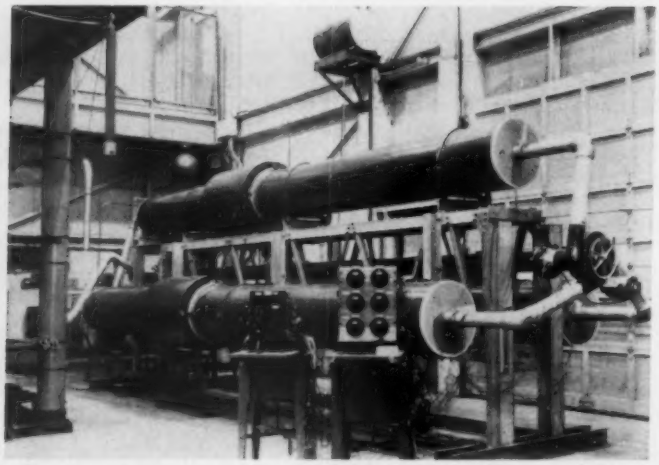




Peg board hung in reception room of main plant of Electric Machinery Mfg Co in Minneapolis. It displays items made by company, asks for ideas from vendors and suppliers on how to improve quality and cut costs of the various components. Board has worked out very successfully

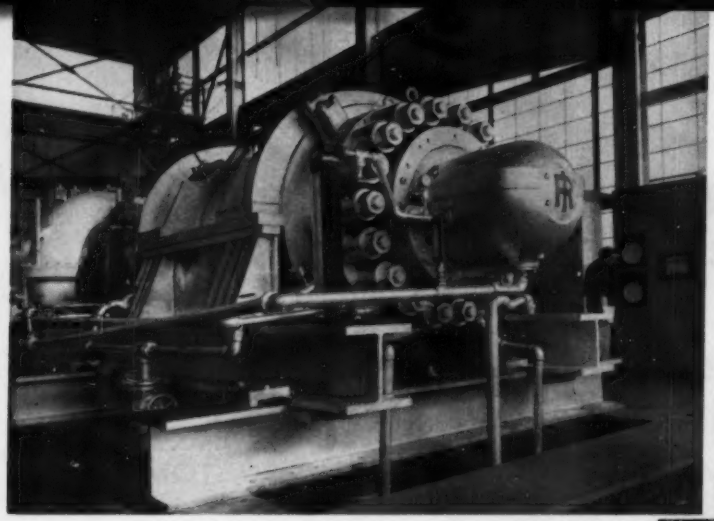
Power Engineering's

Separate ring-type nozzle chests and inner cylinder blade rings are used by Allis-Chalmers to minimize distortion and thermal stresses in this h-p cylinder for a 357,000-kw turbine generator



Liquid cooling of 22-ft sections of isolated phase bus in 3-phase arrangement is tested by I-T-E. Savings in operating costs and space are reported for bus runs carrying over 10,000 amp for distances of 200 ft or more. Bus was designed to carry 10,000 amp at 23 kv

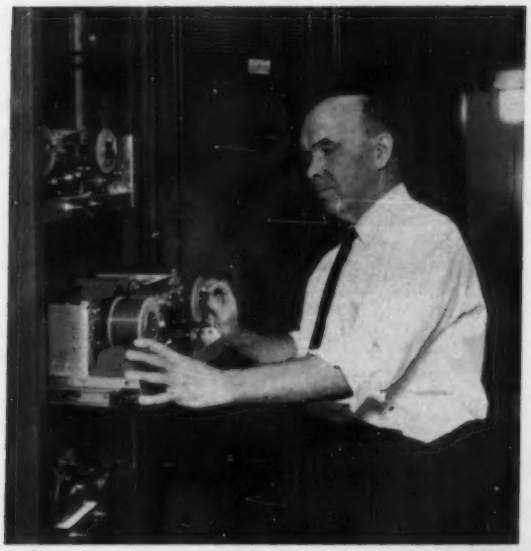
Giant airfoil bladed FD fans, 19 ft high, go into Union Electric's Meramec Plant, Unit No. 4, from American-Standard. Each rated to deliver 414,000 cfm at 100 F, 13.8-in. w.g. static pressure, 590 rpm

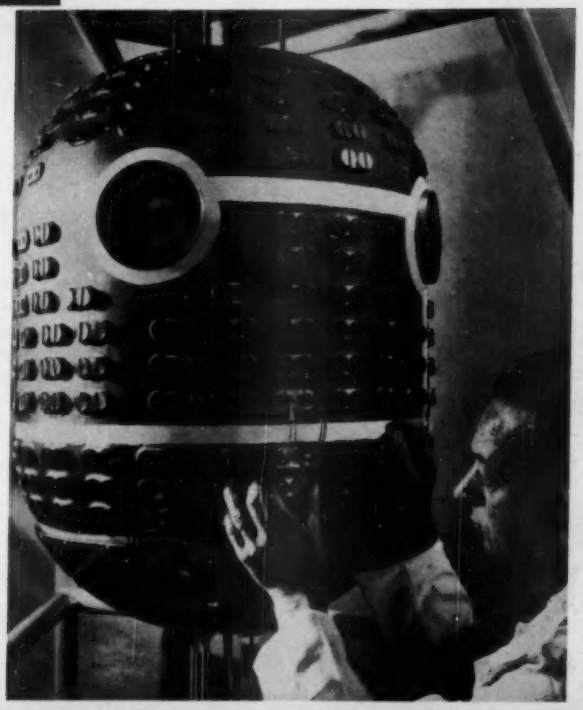


This boiler-feed pump will handle 7200 gpm at 4550 psig discharge pressure, goes into service late this year at Philip Sporn Plant's new 450-Mw generating unit. Made by Ingersoll-Rand, it will alone handle unit's b-f water. A 22,000-bhp turbine drives the pump

Heat from tightly-sealed pellets of an atomic waste material, Cerium-144, will be converted directly into 125 watts of electrical power by hundreds of thermocouples which dot the outer surface of this novel SNAP 1-A generator by the Martin Co. It's 34 in. long

NEWS REEL





Tape recorders-reproducers by Soundscriber Corp are used by Public Service Electric & Gas Co to monitor all telephone conversations made by load dispatchers in the company's newly-completed communications center, Newark, N.J.

One-piece 44-in. forging of Discaloy alloy will be used in 22,000-kw gas turbine being made by Westinghouse for peak shaving at Philadelphia Electric. Turbine blades will be mounted around disk, which will operate at 1100-1250 F

HOW WE CHANGED OVER FROM 2400 VOLTS TO 2400/4160 VOLTS WYE

M. L. MONSON, SUPERINTENDENT OF THIS MUNICIPAL UTILITY, DESCRIBES METHOD OF SYSTEM CHANGE-OVER THAT WAS BOTH ECONOMICAL AND EASY ON THE CUSTOMERS

REASON we made this change in 1954 at Fosston Municipal Utilities, Minn, was that our load was growing rapidly, and also we had begun to purchase power from the Minnkota Power Co-operative. Our switchgear was too small and interrupting capacity was not large enough.

New switchboard was installed in an addition built onto the present diesel plant building, and the connection to the diesel engine was made through a one-to-one 2400-v transformer. The primary to which the generating plant was connected was hooked up 2400-v delta, and the secondary of the transformer was connected 2400/4160-v wye so as to convert the power from the generated to 4160-v wye for distribution.

This made it fairly simple to convert the system, as the old board was used to feed the three circuits of the distribution system at 2400-v delta until such time as the preliminary work on the circuit was completed so as to make the change-over. The power was fed into the old board through the one-to-one ratio transformers from transmission line.

Preliminary work in making the change-over was then started. A crew was sent out to check all the neutral connections and to see that all the neutrals on the system were tied in. A heavier conductor was installed in the neutral circuit from the power plant to a point where the two circuits branched out. This neutral conductor was grounded at every pole from the plant to a point of eight pole spans. After this, all the trees in our primary circuit were trimmed for proper clearances.

A phase map was made of each one of the three circuits. In order not to inconvenience the customers, it was decided to make the change-over just before daylight on a Sunday.

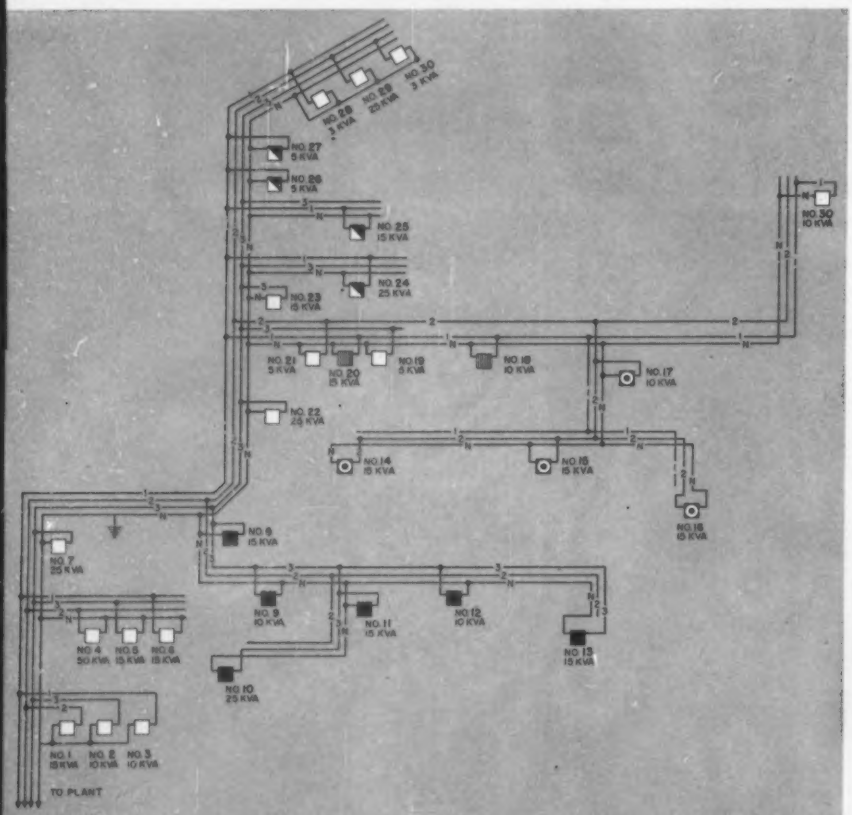
After the date was set, the crews were called in and given instructions on procedure. Foreman of each crew was given a phase map, and he was made responsible for the work in a certain section of the circuit. The current was shut off on one circuit at about 4 a.m. Work was completed by 7:30 a.m. and the current on.

After the changes were made on this circuit, the crews reported into the plant and the power was turned on. We had the correct phase rotation on the first circuit, but on the other two circuits we had to reverse two of the phase wires. All the phases were connected to each three-phase transformer bank so that they would have the same phase relationship to each other. Thus we avoided having to check the phase rotation of each transformer bank individually.

Cost of making the change-over was very low. We figure that the total labor cost of our own crews and the outside crews was not over $950.

A phase map is reproduced here. The transformers having the same designation are connected in parallel. This map is kept in the plant so that anyone can see at a glance the transformers that are paralleled.

We have also checked the phasing of the two feeders that come near each other on the same cross arm at the plant, and each phase of one circuit is numbered the same number as the phase of the other circuit. In this way, it is possible to jumper or by-pass one circuit from the plant if any work is to be done on the particular circuit or on the switch panel in the plant. THE END



Power Engineering

MORE ON ECONOMICAL SELECTION OF SURFACE CONDENSERS

AUTHOR S. M. AUSTIN OF ALLIS-CHALMERS CONTINUES HIS DISCUSSION FROM A PREVIOUS ISSUE

ECONOMICAL selection of steam condensers involves many factors, and all should be carefully considered. In an earlier issue, we discussed a number of these factors; now, we'll cover the rest of them.

Probably the most common material used for condenser tubes is admiralty metal, a 70 per cent copper, 29 per cent zinc, 1 per cent tin combination. This alloy has the highest heat transfer and has proved best suited for the largest number of installations. However, there are a number of other tube materials available, and Fig. 1 shows how they affect the condenser size and price. Notice that the use of aluminum as a condenser tube material has only recently been considered; and no broad recommendations for its use can be made here.

Figure 1 does not include information on stainless steel tubes, but their use would add materially to the cost of the condenser, possibly to the point of exclusion, except in extreme cases.

Cooling-Water Velocity

Cooling-water velocity is certainly one of the prime considerations in condenser design. The normal velocity range is from 6 to 8 fps. Heat transfer is improved with the higher velocity, but the friction loss also increases. Higher velocities result in larger quantities of cooling water, and less condenser surface, required to do the same job.

Figure 3 shows that with 6-ft velocity, an 87,000-sq ft condenser would be required, whereas by going to 8-ft velocity the surface is reduced to 72,000 sq ft, with a corresponding reduction of 16 per cent in first cost.

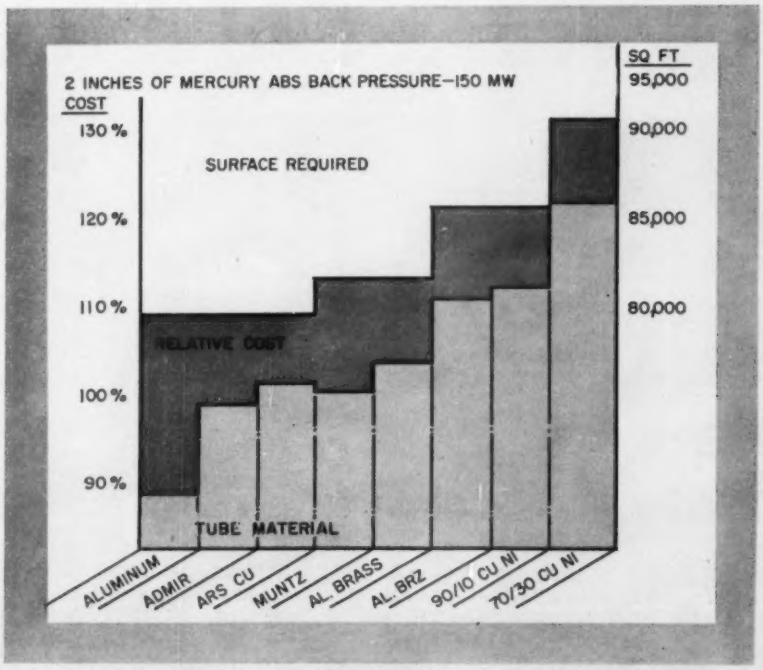


Fig. 1. Various available tube materials affect size and price of condensers

Deciding on a design velocity figure is contingent upon many things, including the possible effect on condenser tube life, due to possible increased erosion, or corrosion, with higher velocities. Since friction increases approximately as the square of the velocity, the bhp requirements to pump the cooling water through the condenser are also of importance. The most generally accepted velocity with average, to good, water is 7 fps.

Cleanliness-Factor

Most commonly used cleanliness-factor is 85 per cent, which means essentially that with tubes in the condenser only 85 per cent clean, it performs as an equivalent smaller condenser with tubes 100 per cent clean. Thus, the cleanliness-factor amounts to sort of an insurance against the necessity for cleaning the condenser too frequently.

Generally speaking, if water conditions are about average, an 85 per cent factor is recommended. In more fortunate locations, the use of 90 to 100 per cent cleanliness-factor might be justified. On the other hand, where water used for cooling purposes is extremely contaminated, a lower cleanliness-factor should be used.

Figure 2 shows how the use of different cleanliness-factors may affect the size and price of a condenser. For instance, the difference between using a cleanliness-factor of 70 per cent, rather than 100 per cent, results in an increased cost of approximately 25 per cent; so obviously this item deserves attention.

The graphs illustrate how important each design variable can be. Of course, in the final analysis, all of them must be considered together, plus some of the less tangible aspects which are not so easy to evaluate.

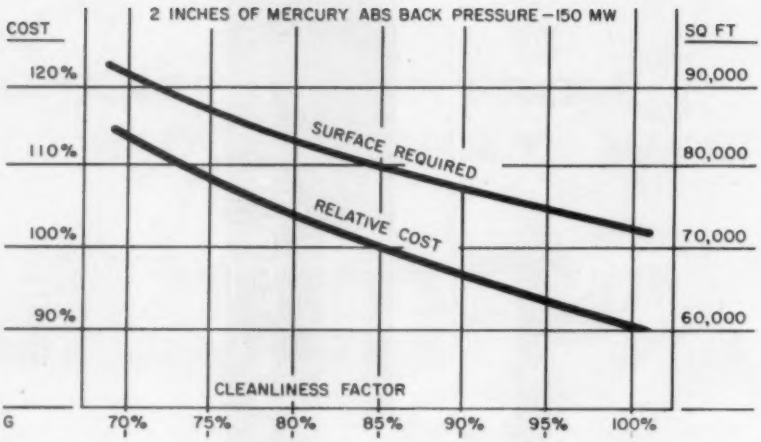


Fig. 2. Different cleanliness-factors influence size and price of condensers

Determining Condenser Shape

Condenser proportioning, from the standpoint of surface square-footage and cooling-water quantity, has been discussed. Before, and after, determining the amount of surface required, consideration must be given to the condenser shape, since every condenser is *tailor made*. The smaller sizes are very often round, but a rectangular configuration is the most popular condenser shape today.

This has been brought about by the advent of the steel water box, which allows the use of almost any rectangular dimension which will best fit the space available. The scarcity of room for the condenser has always been a problem, and is certainly understandable in view of rising plant costs.

Also, the shape must be such that the steam distribution is adequate and condensate pumps have sufficient sealing head. Further, erection problems and how the condenser should be sectionalized for ease of handling (during both shipment and erection) should be considered. Generally speaking, to minimize erection costs each condenser piece should be made as large as transportation facilities will allow.

Figures 4 to 6 illustrate various condenser snapes and arrangements. Figure 5 is an end view of a round condenser; this shape is normally restricted to the smaller size units — from 36 to 144 in. in diameter. This is a rather roomy installation, with a fair amount of clearance between the turbine foundation, and it uses horizontal condensate pumps, which necessitates room for hot well and pump-sealing head.

Figure 6 shows a considerably larger 50,000-sq ft condenser of an oval design, a shape which was adopted to limit the over-all height and would become excessive if a round configuration were used. The water boxes in this instance are of cast iron, and the foundation clearances are rather tight, with much of the piping being carried out of the foundation, over the top of the condenser. This requires very careful planning.

Figure 4 shows an end view of a 200,000-sq ft rectangular-shaped unit, utilizing *steel* water boxes. This shape takes advantage of all available space

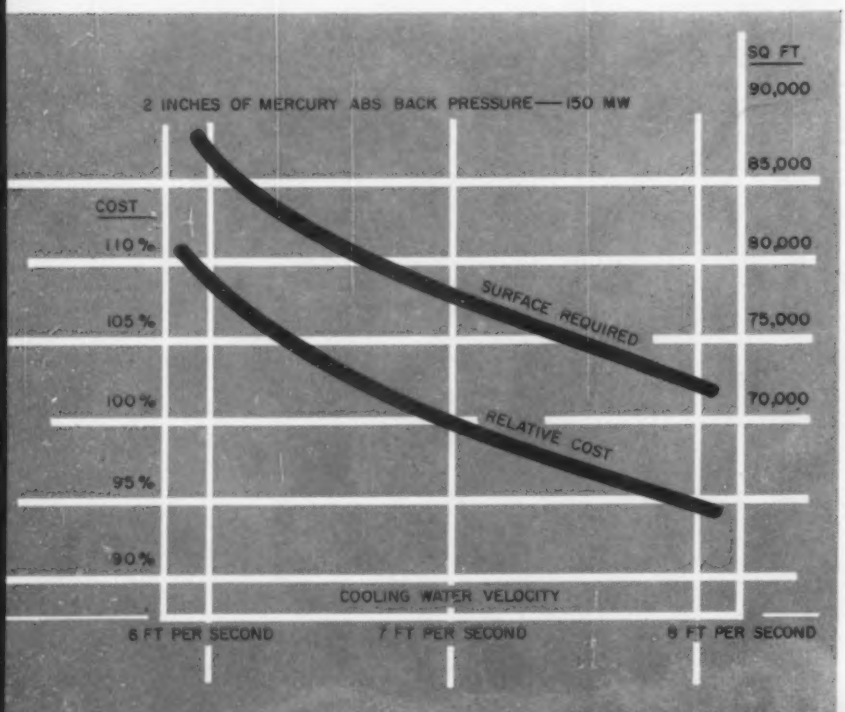


Fig. 3. Surface required and the cost are weighed in design velocity figures

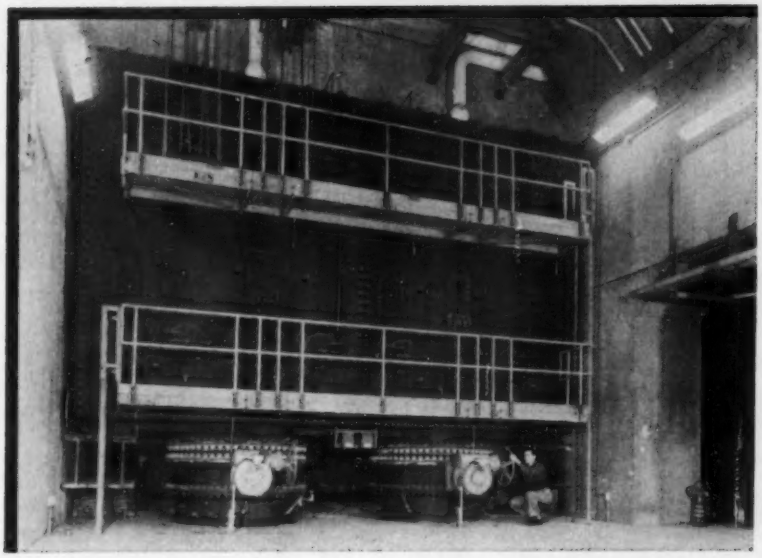


Fig. 4. This 200 000-sq ft rectangular unit is advantageous in limited spaces

and tends to minimize the required basement height at appreciable saving in plant cost.

Fabrication and Transportation

As mentioned in reference to condenser shape, welded steel construction allows much more freedom to the condenser designer in selecting a size and shape, consistent with optimum performance, that is suitable for a given installation. With cast iron construction it was necessary to assemble shell sections from a large number of pieces, all bolted together — each joint representing a potential source of air leakage. Today, the use of better materials conveys two more advantages, in that modern welded units are shipped in a minimum number of pieces, for ease in field-erection, and when welded at assembly, form an air-tight vessel that is trouble-free for the life of the equipment.

Obviously, as the size of units has increased, condenser designers are confronted with the problem of manufacturing and shipping these larger and larger pieces. In the endeavor to keep the number of pieces (and field-erection cost) at a minimum, one important factor is transportation.

Solution to Problem

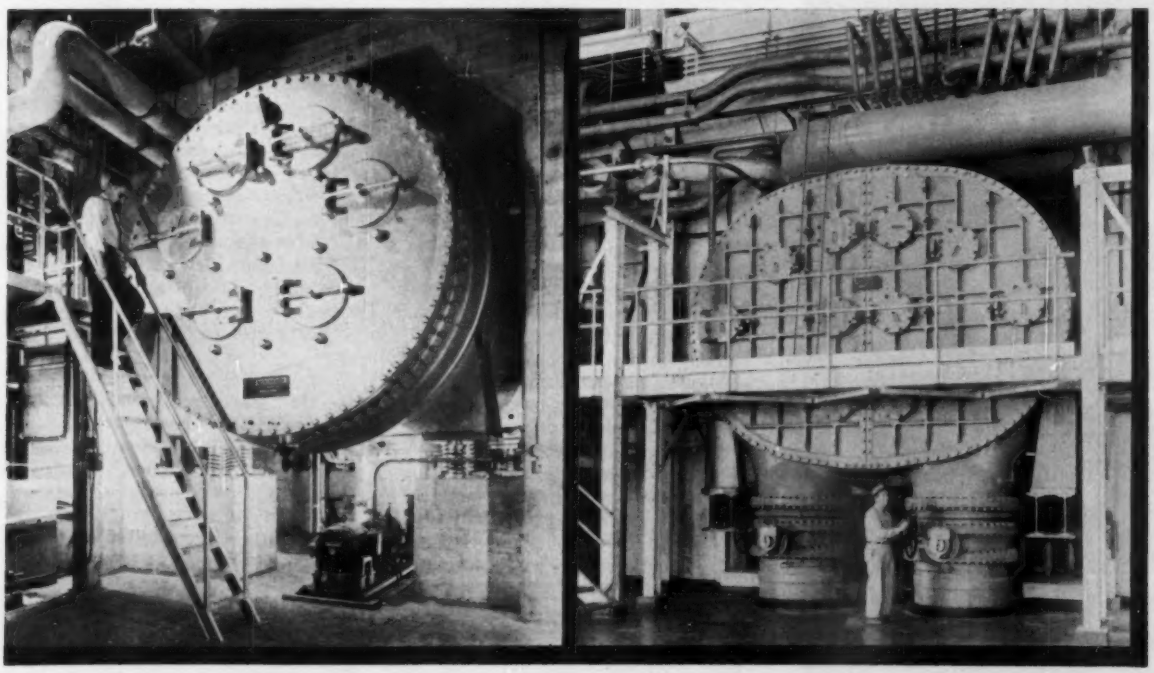
One solution to this problem is a special well-type car, with an opening 10 ft wide inside the side channels, and 30 ft long. Prior to this, condenser sections were limited to approximately a 6 ft 8 in. width. This type car is extremely valuable where unusual height clearances are required. A piece can be shipped, which rides approximately four inches above the rails.

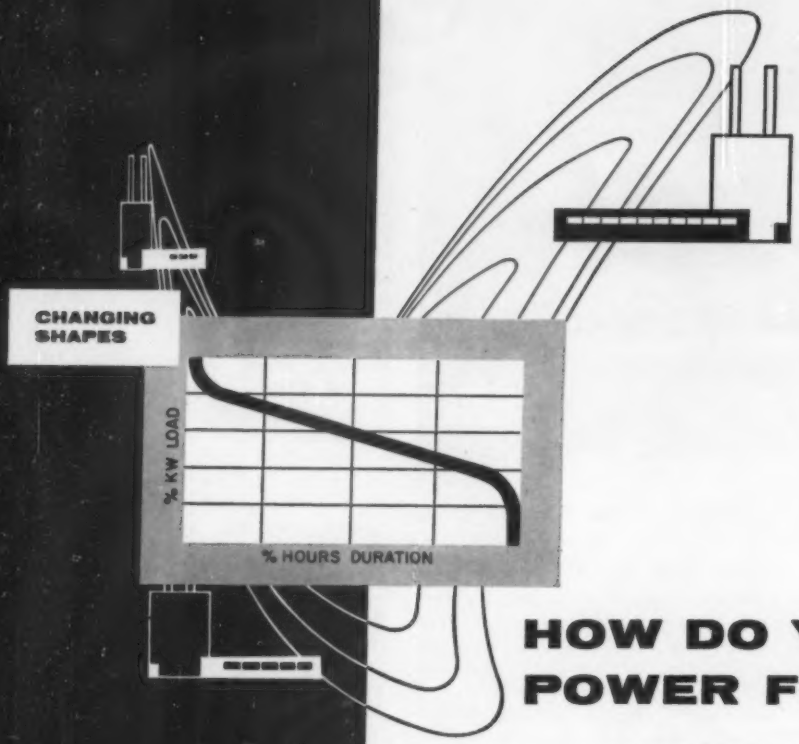
Pieces have been shipped on these cars with a 19-ft 6-in. clearance above the rail. When the shell section does not require this maximum height clearance, standard depressed-type cars are used.

This article has pointed out the many factors involved in the proportioning of a steam surface condenser, and has tried to emphasize the amount of consideration necessary in the selection of a unit. In conclusion, let it be stated that at the very least, the steam condenser is an extremely important part of the power plant, and it should be carefully chosen, if for no other reason than that it represents considerable expense. THE END

Fig. 5. Round condensers are often better in smaller units

Fig. 6. Oval condensers limit over-all height in small areas





HOW DO YOU OBTAIN POWER FOR PEAKING?

ANSWERS IN SPECIAL SECTION

COMING IN OCTOBER ISSUE

Interconnections

Power Pools

Steam Turbines

Diesels

Gas Turbines

Hydro Plants

Pumped Storage

What It Costs

HERE IS an old problem in a new guise. If you haven't got any more old plants to put on the peak, and have to run newer and more efficient plants farther up on the load curve, what do you do to keep costs down?

Here are the principal methods now being used and advocated for supplying that 10 per cent of your load that comes on for only 5 per cent of the time.

1. First look to interconnections and power pools, and "wheeling" arrangements, to see if they can supply your peaks.

2. What can you do with steam plants for peaking — a "bare-bones" plant; a unit with pressure increased and lower temperature, with heaters cut out or reheat by-passed; or spinning reserve units?

3. Can you use automatic, remotely-located diesel engine plants on your peak? Several utilities are already doing this in several ways, and you'll read about them in October.

4. Gas turbines, too, can shave peaks. Here, too, a number of companies are using them and planning to use them. We'll tell you how they are doing it.

5. Can you use hydroelectric plants, existing or projected, to help your other sources of power on the peaks?

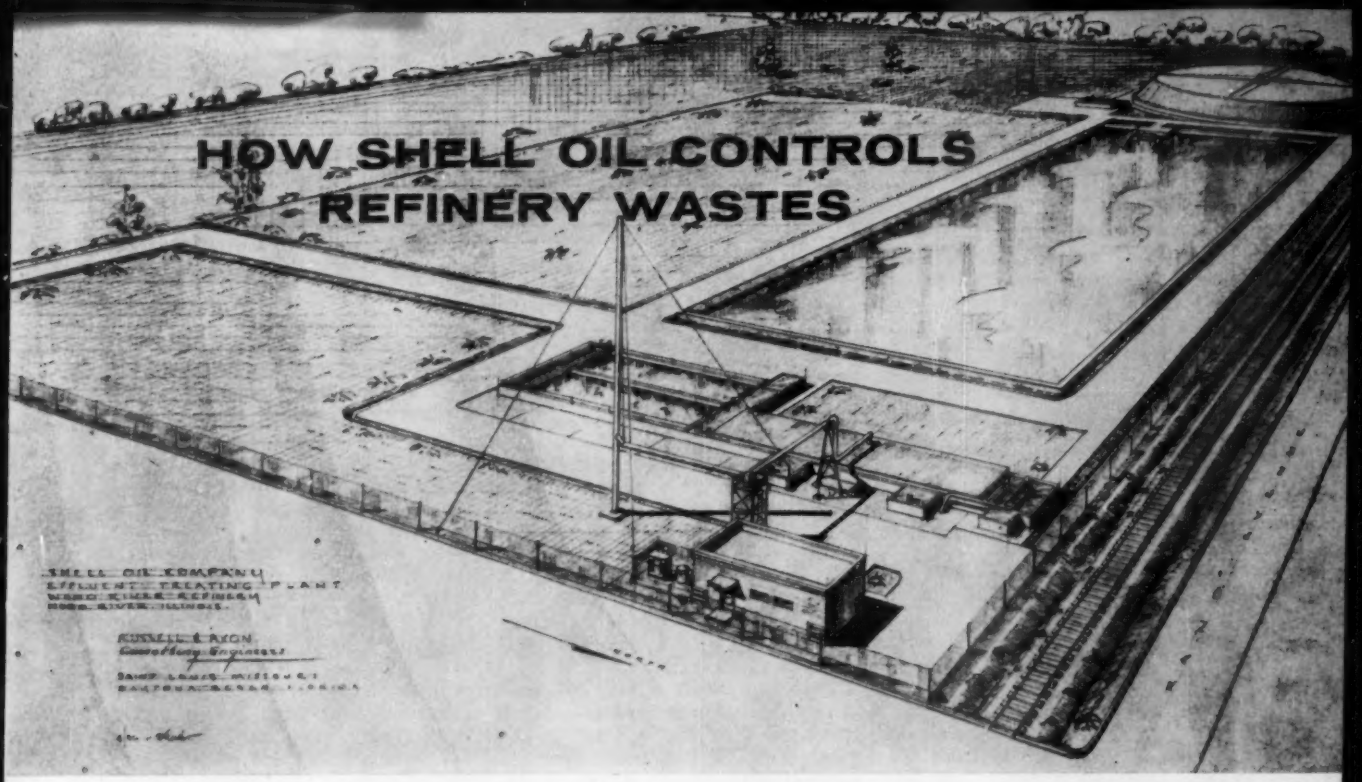
6. Can you develop pumped storage hydroelectric plants for peaking? Not many are in operation yet in the U. S., but many people are studying their possibilities, especially since the development of the reversible pump-turbine.

7. What does peaking power cost? Do you know the various methods of figuring costs on decentralized peak-shaving units, on modified steam units, on diesels and gas turbines, on pumped-storage? Our special section will review them.

Outstanding power engineers will give you specific figures and case histories and will discuss the different methods of approach to the peaking problem. That problem, says one of those authorities, will grow more acute from now on, rather than less so. And it is the power engineers who read POWER ENGINEERING who will be key factors in solving it for their particular systems and companies.

Read all about it in our coming October issue.

HOW SHELL OIL CONTROLS REFINERY WASTES



CONTROL OF pH, AERATION, AND BIOCHEMICAL OXIDATION ON A TRICKLE FILTER ARE COMBINED IN NEW $1,000,000 FACILITY

SHELL OIL CO's Wood River Refinery is located in Illinois about 15 miles north of East St. Louis. Waste waters from the refinery are discharged to the Mississippi River some two miles to the west at a point just above the confluence of the Mississippi and Missouri Rivers, and only a few miles above the water intake of the East St. Louis and Interurban Water Co, which supplies domestic water to about 300,000 people.

When the refinery began operating in 1917, there was little need for waste water treatment facilities other than separator boxes for oil removal; however, as the industries in the area grew in size and complexity, with an accompanying growth of the municipalities, there was increased pollution of the river. Shell adopted a general policy of controlling potential pollutants at their individual sources. This effected a considerable improvement; however, there remained some small contributions of contaminants from a number of sources difficult to detect or which were individually of too small a quantity for removal at the source.

A detailed study of the possible methods for further improving the quality of the waste water indicated that for such marginal sources, treatment of the total refinery effluent would be most effective and economical. For such a final treatment, consideration was given to most of the known methods of treatment and disposal, including chemical treatments, biological treatment, solvent extraction and deep well disposal.

3-Step Treatment

After extensive experimental and pilot plant work, an effective three-step treating procedure was worked out. These steps and procedure are explained as follows by L. C. Burroughs, assistant to vice-president manufacturing, Shell Oil, New York City, and by G. E. Sample, manager effluent control department of the Shell Oil plant at Wood River. The following description by Burroughs and Sample is based on an article by them published in the *Journal* of the Missouri Water and Sewerage Conference.

1. Control of pH before the final refinery oil-water separator by automatically controlled addition of acid or caustic as required for maintenance of a pH of 8.0 to 8.5. This is essential for effective oil removal in the separator and for the treating steps which follow.

2. Aeration of waste water for reduction of oil content by flotation, and of sulfides, mercaptans, and easily oxidizable organics by air oxidation.

3. Biochemical oxidation, on a trickle filter, of the aerated waste water after settling. This step is for the reduction of the phenols and other soluble organic compounds.

Early in 1956 the refinery crude oil intake was increased some 50,000 barrels per day, and the decision was made to proceed with the construction of the facilities for waste water improvement, as well as to provide for the wastes resulting from processing the additional crude oil.

Approximately $1,000,000 was allocated for the construction of the necessary facilities for the three-step treating procedure. Actual construction work was begun early in 1957 and completed by the end of the year. The entire waste water handling system for the refinery is shown schematically in Fig. 1 (next page).

First part of the new treating facilities is the pH control equipment ahead of the existing final oil/water separator box within the refinery

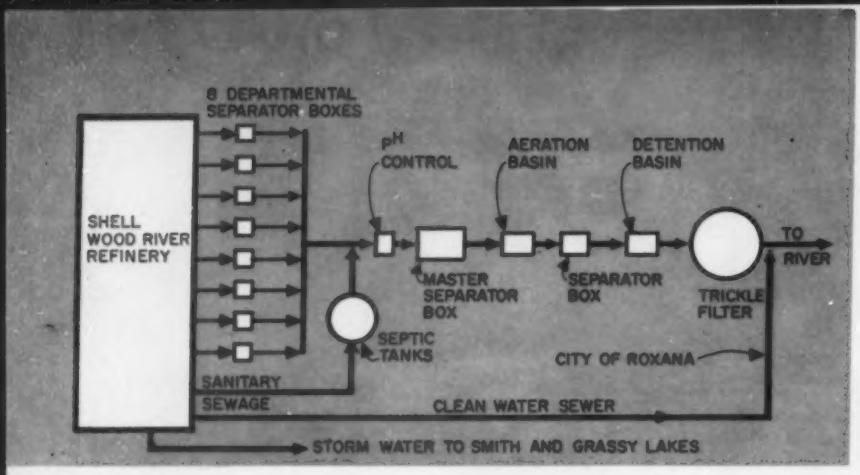


Fig. 1. Schematic of wastes handling system at Shell Oil's Wood River refinery. System completely removes sulfides and mercaptans, reduces phenols 75-85 per cent, reduces threshold odor 95 per cent

proper. This is shown schematically in Fig. 2.

The pH is controlled to about 8.0 to 8.5 to improve the efficiency of the separator box and to assure proper operation of the following steps. Caustic or acid is added automatically as required by the pH control device (Beckman analyzer, Brown recorder and controller). These chemicals flow by gravity from the storage tanks to a sewer box approximately 30 ft upstream from the inlet section of the separator box.

Proper mixing and neutralization are accomplished by the turbulent flow in the sewer ahead of the separator inlet. A one-gpm pump, and spare, continuously pump inlet water to the control meter for measurement of the pH. An alarm system with a red light and horn is provided to alert the operator to failure of the chemical injection equipment.

Water from the final refinery separator flows by gravity through a 36-in. sewer to the new treating plant area which is located about one-quarter of a mile west of the refinery proper.

Here in the treating plant area the water is lifted to the aeration unit; lifting is accomplished by two 6000-gpm pumps, one of which operates continuously and the other operates only on a high level in the sump. A float-operated by-pass valve is provided on the pump discharge to permit the pumps to handle less than their full rated capacity.

Two 1-in. mesh screens are provided ahead of the pumps. These screens are set one in front of the other. When the front screen becomes plugged with debris, it can be removed for cleaning. After cleaning, this screen is placed behind the screen already in place. In this manner it is possible to clean the screens without removing both from the line. An angle-type flow meter is provided on the sump pump discharge to measure and record the flow to the treating plant. The lift pump discharges to the aeration tank inlet which is provided with ¼-in. mesh double screens which are cleaned in the same manner as the lift sump screens.

Aeration

Aeration tank, Fig. 3, is divided into four compartments in series, each compartment being about 16 ft wide, 16 ft long and having a 15-ft depth of water. Total residence time at design flow is about 27 minutes.

Each compartment is equipped with a removable assembly containing four clusters of air diffusers. Each cluster contains six air diffusers for a total of 24 per compartment or 96 in all. The air diffusers are standard cast iron Pemberthy No. 5-A eductors. Diffusion is obtained by pumping water and air concurrently through the eductors.

Each diffuser receives 8–9 SCFM air and 21 gpm of water. Total air is supplied by a 860-SCFM blower at 9 psig. The 2000 gpm of water is supplied to the diffusers by two 1000-gpm pumps at 60-ft head. One of these pumps takes water from the first compartment and discharges to the diffusers in the first and second compartments. The other pump takes suction on the third compartment and discharges to the diffusers in the third and fourth compartments.

Diffusers have a water orifice of approximately ⅜-in. diameter. Plugging of one or two of these will upset the air distribution in the entire tank. It is for this reason that the ¼-in. mesh screens are provided in the aeration tank. The quantities of air and water used in the diffusers were determined experimentally to be the most economical in power requirements for the results desired.

Aeration basin is covered with removable prefabricated aluminum panels. Draft fan is provided to exhaust air from under the roof to a 75-ft-high stack. Continuous hydrogen sulfide analyzer on the stack

Fig. 2. First step is pH control, which takes place ahead of final oil/water separator box within the refinery proper

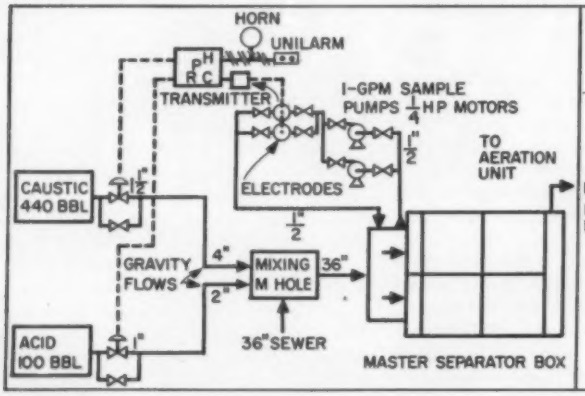
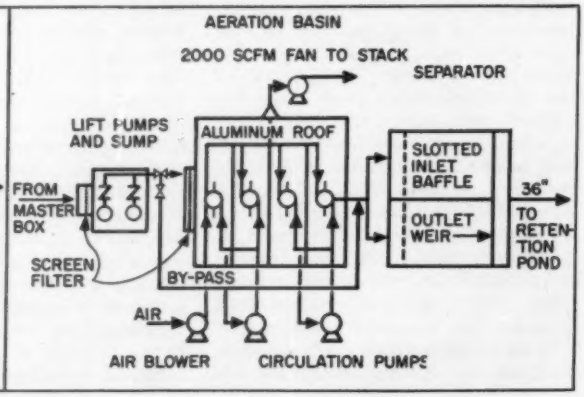


Fig. 3. From master box, water is lifted to aeration basin and then flows to separator box for removal of oil and solids



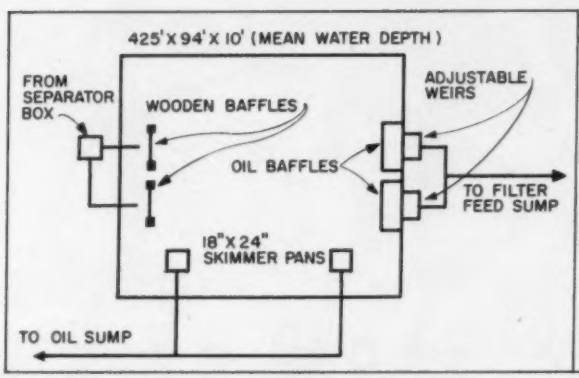


Fig. 4. Water then flows by gravity to the detention pond, which gives settling time for final removal of oil and solids

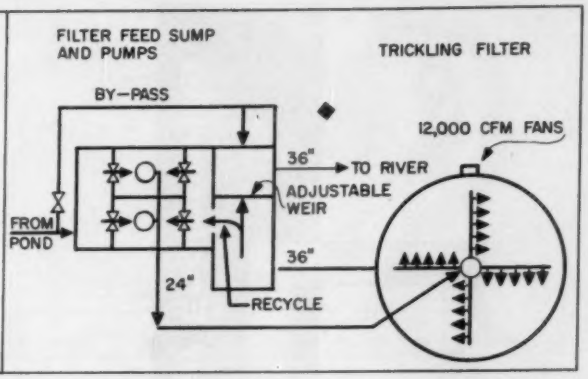


Fig. 5. Finally, filter feed sump moves water to the trickle filter for reduction of phenols and other soluble compounds

gases sounds an alarm if hydrogen sulfide is emitted from the stack. At such times the pH of the water can be raised to suppress the stripping of the hydrogen sulfide.

From the aeration unit the water flows to a separator box, Fig. 3, approximately 50 ft long with two parallel compartments 16 ft wide and 7 ft deep, for the removal of air-floated oil and solids. Residence time is about 20 minutes. Oil skimmings are returned to the refinery for treatment. The box is provided with a vertical slotted inlet baffle, continuous flight scrapper, slotted pipe oil skimmers with extension lips, and a sloping wall hopper-type sludge pit into which the sludge is moved by the scrapers.

Sludge is removed from this pit by use of a reciprocating pump and a 4-in.-diam flexible suction hose. Use of reciprocating pumps and flexible hose for desludging has proved satisfactory at other separators in this refinery. A reciprocating pump provides a positive suction, the flexible hose permits lifting to clean the basket screen on the end of the hose, and permits working the hose into the sludge hopper at a rate to obtain a slurry of proper consistency for pumping. Sludge slurry is pumped to a pond in the refinery where the solids settle out and clean water overflows to the refinery sewer system.

Purpose of this aeration unit and separator combination is to reduce sulfide and mercaptan contents of the water by air oxidation, and to reduce the oil and solids contents by air flotation. Design is based on oxidation of about 20-ppm sulfides and 3-ppm mercaptans, and reduction of oil content of about 75 per cent. Provision has been made for the installation of another aeration tank on the west side of the present unit if required later.

The pH of the water in the aeration tank is quite important. At pH values much above 9 the oxidation of sulfides is greatly reduced, while at a pH of below 7.5 to 8.0 some hydrogen sulfide is stripped from the water by the air.

Detention Basin

From the separator box the water flows by gravity to the detention basin, Fig. 4. This basin provides settling time for the final removal of oil and solids, and helps to equalize variations in temperature and composition of the water for charge to the trickle filter. The basin is equipped with two inlets and two outlets for better flow distribution. Each outlet is provided with an oil baffle and an adjustable weir for regulating the water level. This basin has a capacity of about 3,000,000 gallons for a normal residence time of about 12 hours. It is paved with 3-in.-thick asphaltic concrete.

Trickle Filter

From the detention basin the water flows to the filter feed sump from where it is pumped to the trickle filter, Fig. 5. Pumping is done by either or both of two 8000-gpm pumps which discharge to the four-arm distributor of the filter. The distributor was designed by Walker Process Co to handle from 8000 to 16,000 gpm of water.

Filter is 10 ft deep and 140 ft in diameter at the top with sides sloping at a 1/1 slope to a 3-ft-high wall at the outside. Filter medium is 2½ to 4-in. blast furnace slag. Underdrain system uses conventional slotted tile under the body of the slag with a gallery across the entire diameter of the filter.

Water from the filter returns to the outlet section of the sump where a portion is recycled to the filter and the remainder overflows the weir to the river. With the normal inflow of about 4000 gpm, there will be about 1/1 recycle ratio with one pump in operation, or 3/1 with two.

During the first summer of operation the efficiency of the filter was seriously reduced because of insufficient air flow through the filterbed. This was due to the loss of the stack effect in the filter because the air and water were near the same temperature. To overcome this situation, a 12,000-cfm fan was placed in one end of the tunnel under the filter to provide a forced draft of air. Other end of the tunnel and outside openings of the underdrains were sealed to prevent air leakage.

Considerable pilot plant work has been done at Wood River on the trickle filtration of aerated refinery effluent. Work was done using 5-, 10- and 20-ft deep filters at loadings of 5 to 90 million gal per acre a day.

It has been found that sulfides above about 10 ppm in the filter charge reduce the efficiency of the filter. BOD removal is quite low in the upper section of the filter in which the sulfides are being removed. Since the waste water may at times exceed 10-ppm sulfides, provision was made for sufficient recycle so that the combined charge would contain less than 10-ppm sulfides. This is the main purpose for providing the 1/1 and 3/1 recycle.

With the increased hydraulic loadings caused by the necessary recycle, the most practical filter size for 80 per cent phenol removal was the 10-ft-deep, 140-ft-diam filter. Hydraulic loading is about 34 mgad for one pump and 68 mgad for two-pump operation. The combination of aeration unit size and trickle filter size and dimensions is near the most economical for obtaining the desired effluent improvement.

Test results show that the facilities completely remove sulfides and mercaptans, effect a 75 per cent to 85 per cent reduction in phenols, oil and solids, and reduce threshold odor about 95 per cent. THE END

Power Engineering

FORD'S 44-YEAR-OLD POWER PLANT SURRENDERS TO PROGRESS

MARVEL of the industrial production world in its day was the Highland Park, Michigan, plant of Ford Motor Co. To power engineers, the great power plant that served it was also a world-famous landmark for over 44 years, one of the biggest isolated industrial power plants in the world.

But last year that great power plant was razed, as part of a modernization program at Highland Park, and has been replaced by a modern installation. For the interest of the many power engineers who remember the original power plant, we show it here as it was in its heyday, and as it was being demolished. Then we show the modern boiler plant that has replaced it.

It was necessary to build a new boiler plant because the company's properties along Woodward Avenue were sold. Removal of part of G building provided space alongside the P building for erection of the new boiler plant.

Founder of the company, Henry Ford, was always interested in the power facilities of its plants, because he himself had been a power engineer with Detroit Edison Co. At the peak of its production in 1923, the Highland Park plant was served by the largest industrial power plant in the United States. That power house was

Fig. 1. BEFORE: View of Highland Park plant of Ford Motor Co as it appeared in 1923, showing prominence of power plant

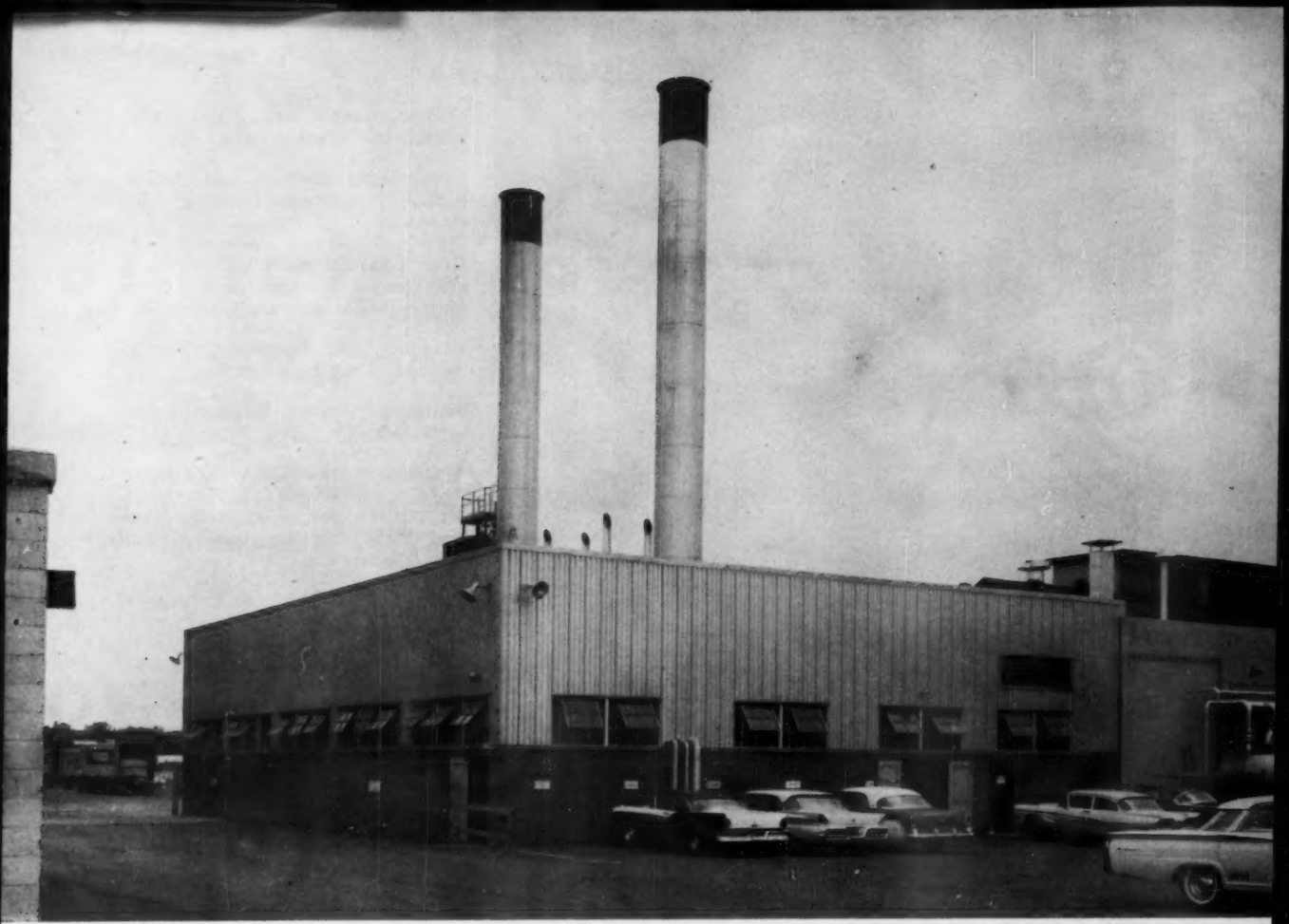


Fig. 2. NOW: Here is a view of the present modern boiler house. This has replaced the one that is shown in Figure 1

erected in 1915. It contained a number of large reciprocating steam engines, which were later converted to combination gas-steam engines, the gas being supplied by a gas producer plant located on the property. The boiler house contained a total of seven boilers, fired originally by hand, later by coke breeze and coal grate, with a total steam capacity of 350,000 lb per hr.

Fig. 3. Demolition in 1959; first stack comes down, others the following day

Over the years, the production facilities of the Highland Park plant have been used for the manufacture first of the famous Model T automobile. During World War I, the plant switched to the manufacture of military equipment. After that war, it manufactured, in addition to automobiles, a variety of products such as artificial leather, glass, cloth, steel balls, copper wire, roller bearings, generators, storage batteries, and radiators. As the new plant at the Rouge developed, operations were gradually curtailed at Highland Park. But World War II brought it a new lease on life and again it produced much military equipment.

After that war, tractor manufacture started and is now Highland Park's most important activity, along with truck and bus manufacture. The company is now conducting a multimillion dollar expansion of the plant and, as part of its modernization program, has constructed the new power plant, above, to replace the old one.

The new plant contains four package boilers with a total rated capacity of 200,000 lb per hr, but does not generate electric power. That is all purchased from The Detroit Edison Co.

This new plant is located next to the existing P building, in which are located the plant air compressors, which are under the control of the utilities or power engineers.

The new boiler house contains four 50,000-lb-per-hr gas- and oil-fired steam generators with full automatic combustion control and flame failure system, hot process water softener, one electric and two steam-driven boiler feed pumps. A 5000-bbl oil storage tank is provided for standby fuel. Electric power for the boiler house is supplied from a 440-v substation in an adjacent building, while telephone and signal systems are extended from the present plant systems.

Accompanying photographs show exterior and interior of the new boiler house, and a detailed list of its equipment is also given on the following page.

Turn the page →

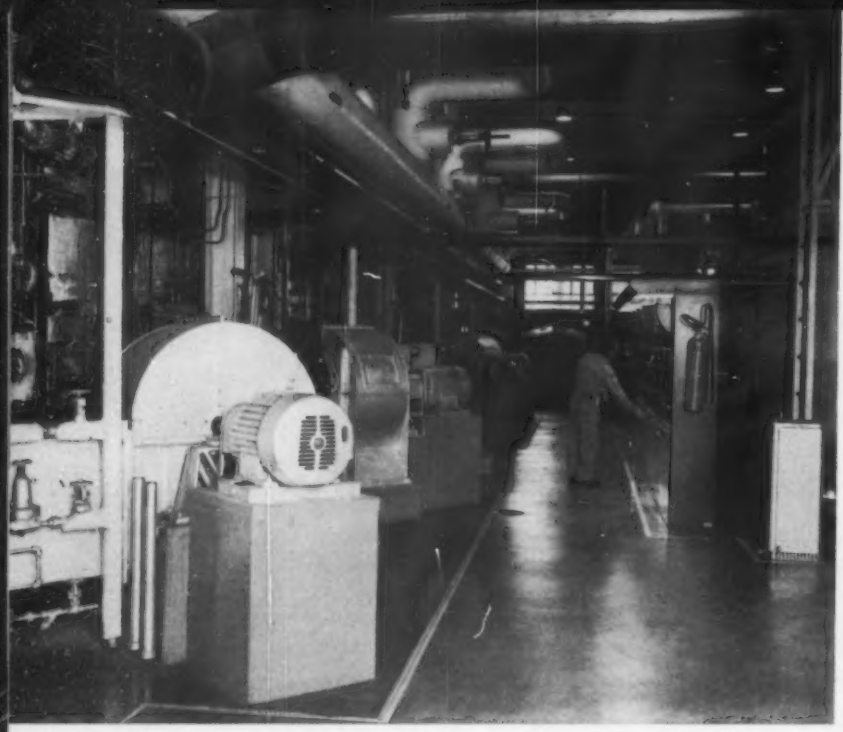


Fig. 4. This is an interior view of the new boiler house shown in Fig. 2

List of Equipment, New Boiler House Highland Park, Michigan Plant Ford Motor Co.

BOILERS: — 4, Type DK, 2-drum water-tube, package type; each 50,000 lb per hr, design pressure 200 psi, operating pressure 165 psi. E. Keeler & Co.

BURNERS: — 2 per boiler, combination gas and fuel oil, steam atomizing, gas pilot with electric ignition. Todd Shipyard Corp.

FLAME FAILURE SYSTEM: — 1 per boiler, low water cut-off, low oil temperature cut-off, purge position, low fire start, furnace draft control for light-off. Fireye SC2.

FORCED-DRAFT FANS: — 1 per boiler, 13,300 cfm each, 25-hp motor drive. Clarage Fan Co.

BOILER TRIM: — Consolidated safety valves; Magnetrol and Huyette water columns and gages; Yarway blow-off valves; Diamond soot blowers; Swartwout feedwater regulators; Ashcroft steam gages.

STEEL STACKS: — 2 (1 per 2 boilers), each 5-ft diameter, 50 ft high. American Boiler Works.

COMBUSTION CONTROL AND INSTRUMENTS: — Republic Flow Meters Co.

FUEL OIL SYSTEM: — 5000-bbl steel storage tank; Davis tank heater; 1 De Laval Imo 100-gpm fuel unloading pump, 7½-hp motor drive; 2 fuel oil pumps, De Laval Imo, each 34 gpm, 10-hp motor drive; 2 Yuba fuel oil heaters, each 2037 gph; Todd duplex strainers.

BOILER FEEDWATER TREATMENT SYSTEM: — Water softener, hot lime soda, 200,000-gph deaeration, 100,000-gph condensate and treated water; 1 sedimentation tank; 6-nozzle deaerating heater; 3 anthracite-filled pressure filters; 1 lime and soda chemical feed tank with agitator and chemical pump. Cochrane Corp.

TREATED WATER BOOSTER PUMP: — 2 single-stage, 210 gpm each, 5-hp motor. De Laval Steam Turbine Co.

FILTER BACK-WASH PUMP: — 1 single-stage, 340 gpm, 7½-hp motor. De Laval Steam Turbine Co.

BOILER FEED PUMPS: — 3; two 250-gpm, 520-ft head; one with 50-hp motor drive, one with 52-hp, 160-psi Terry steam turbine drive. One 150-gpm, 520-ft head, with 36-hp Terry turbine drive. Pumps by De Laval Steam Turbine Co.

CONTINUOUS BLOW-OFF SYSTEM: — Flash-type, with tank and heat exchanger, sample cooler, high water alarm, etc. Cochrane Corp.

CONDENSATE STORAGE and Return System: — Simmons Boiler & Machine Co.

CONDENSATE BOOSTER PUMPS: — 2 single-stage, 210 gpm each, 7½-hp motor. De Laval Steam Turbine Co.

SULPHITE AND PHOSPHATE TREATMENT: — Proportioneers, Inc.

BLOW-OFF TANK: — Simmons Boiler & Machine Co.

HEATING SYSTEM: — Carrier Corp.

POWER PANELS, Combusion Control Panel, Lighting Panel: — Bull Dog Electric Co.

COMBINATION ACL STARTERS: — Federal Pacific.

TRANSFORMERS: — One 5 kva, 440/110 volts, dry type; one 37½-kva lighting transformer, 480/110 volt, dry type. Standard Transformer Co.

ELECTRIC MOTORS: — ¼ to 10 hp, Delco Products; 25-hp, General Electric Co; 50-hp, Electro Dynamic Division.

BATTERY-POWERED EMERGENCY LIGHTS: — Light Alarm Co.

EXCAVATION, concrete construction, walls & sills, masonry, cement finishes: — F. H. Taylor Co.

STRUCTURAL STEEL ERECTION, metal deck, glazing & caulking, aluminum siding and sash, metal doors: — Edwin G. Smith Co.

POWER PIPING and mechanical equipment: — Dravo Corp.

ROOFING & INSULATION: — J. D. Candler Roofing, Inc.

ELECTRICAL CONTRACTOR: — J. A. Frost Co.

MECHANICAL INSULATION: — Sprinkman & Sons.

PLUMBING: — Allen Industrial Piping; fixtures, American Standard.

BOILER ERECTION: — Seaway Mechanical Contractors.

PAINTING: — H. Waldo Co.

OIL STORAGE TANK: — Chicago Bridge & Iron Co.

GENERAL ENGINEERS AND CONSTRUCTORS: — Dravo Corp.

Power Engineering

FUEL OIL ADDITIVE SAVES FUEL, CUTS MAINTENANCE

ELZA SNOW, SUPERVISOR OF BUILDINGS AND GROUNDS, MINIMIZES CLEANING OF TUBES, SCREENS AND NOZZLES OF SCHOOL HEATING PLANT IN CHICAGO HEIGHTS

EVERY ENGINEER responsible for the operation of boilers wishes that his plant could be supplied with fuel which would flow freely, contain no sediment, build no sludge or deposits in lines and screens, burn clean, and not form fly ash or boiler scale.

Since this cannot be, it becomes the practical engineer's job to balance considerations of burning quality against cost-per-gallon, consumption rate, and maintenance costs to achieve most favorable cost per Btu.

The plant of Bloom Township High School has three 250-hp boilers and one 300 hp, all low pressure. Any three boilers will supply our needs in the coldest weather, so that one boiler can be kept on standby at all times. The adjoining junior college plant has two 100-hp boilers. The high school plant uses No. 6 oil delivered at 160 F and kept at that temperature in our tanks. The two smaller boilers use No. 5 oil, unheated.

We began some years ago to experiment with additives to try to improve our results with the low-cost fuel with which we were supplied. Oil companies generally feel that such additives do little good. However, our boilers have been in operation for 30 years, and I myself have been here since 1933; and as the quality of fuel oils as delivered has dropped off year by year, the need has become more acute.

One major oil company, in a users' manual, devotes nearly a page to a discussion of fuel oil additives and their properties, concluding in part as follows: In most instances, difficulties encountered in the handling and firing of residual fuels are due to faulty installation or improper operation of the installation rather than to any deficiency in the fuel which can be remedied by an additive.

After three years of successful use, we feel that we can't afford *not* to use an additive. The one we finally found which suited our needs is marketed under the trade-name Kor. It is an alkaline-catalyst compound which has given us a hotter, cleaner fire with far fewer maintenance problems.

During the heating season, consumption averages 90 to 125 gallons an hour of No. 6 oil (Bunker C), or a 5500-gal load about every other day in cold weather. Five quarts of additive are used per full load of fuel, added directly to the storage tank during delivery.

One of the most obvious benefits gained from the use of the additive is that trouble with the burner screens has been almost eliminated. Before using the additive, we had to clean screens once a week. Now we clean them all on the first day of each month, and find them less plugged up even so. We use the fuel additive itself as a cleaner.

Fuel lines to our two 100-hp boilers used to plug up frequently on the No. 5 unheated oil. Now, using the additive in the same proportion, this problem has been completely eliminated.

The additive has also eliminated completely one of the nastier jobs in the boiler room — that of scrubbing carbon off burner nozzles with a wire brush. With a hotter fire and more efficient combustion our nozzles simply don't carbon up the way they used to. An occasional wiping with a cloth keeps them clean and in good condition.

Any accurate comparison of fuel consumption and how it has been affected by our use of Kor would probably be impossible. Two of the three winters during which we have been using it regularly have been unusually cold; our student load and indoor-outdoor traffic varies from year to year; and it seems that each school year there are more late afternoon and evening activities at the school, with greater demand on the heating system. However, there is no doubt that the additive pays for itself in fuel economy alone.

Probably a big factor in fuel economy is the additive's action in keeping the fireside clean. With the additive, our flame is one-third shorter because the catalyst action produces a more intense fire. Salts and mineral content of the fuel — the materials which won't burn — become easily controllable fly ash. The shorter, hotter flame does not reach back to the tubes, so these deposits remain as easily removable fly ash instead of baking onto the tubes in the form of slag and scale.

Our boilers are clean and they stay clean. THE END

Bill Siebert shows nozzle which stays clean now, and with no carbon problems

Power Engineering

STATIC RELAYS FORGE AHEAD

COLIN ADAMSON OF MANCHESTER, ENGLAND TRACES RECENT DEVELOPMENT OF STATIC RELAYS FOR POWER SYSTEM PROTECTION

About the Author

Colin Adamson is Senior Lecturer in charge of the Power System Laboratory, Manchester College of Science and Technology, Manchester, England. In England and Europe, he is a well-known authority on power systems, and especially on static relaying. He has just published a book on this subject and visited the United States in 1959 to obtain data on our static relaying practices. Evidence of his authority is the fact that he presented an exhaustive paper on the subject before the Portland, Ore., Seattle, Madison, and Montreal sections of AIEE in October, 1959. This article is based on that paper, and another article in a future issue will compare British and American practice.

FIRST ELECTRONIC protective system incorporated electromagnetic relay elements for controlling tripping, and was described in 1928 by Fitzgerald. The first systems employing electronic static relays were invented slightly later, some of them being described in 1934 by Wideroe. There have been many innovations subsequently, but no substantial adoption of static relaying techniques took place until recently, except in the special case of carrier protection.

This situation is now changing very rapidly indeed; new circuit elements and components are available and, as a most important stimulus, the operating requirements of protective gear are tending to become more stringent. Thus there has been a radical re-examination of the subject of protective relays and equipment, and a substantial amount of new work has been reported and new equipment marketed. In Europe, the greater proportion of the new equipment has been based on the metal rectifier rather than the transistor or transductor, although all have their place.

This paper is primarily concerned with the applications of rectifiers and transistors, since it is the author's contention that they are the key to the protective gear of the future. The metal rectifier is now regarded as a robust, reliable circuit and relay component, which was certainly not the case in Wideroe's day, while the transistor continually inspires greater confidence among power engineers.

Rectifiers and transistors are examples of circuit elements useful in building up a "static" relay; that is, a relay in which there are no moving parts except possibly a slave relay for operating the circuit breaker tripping arrangements. If, as is necessary in the more complex relays, two or more active quantities have to be compared, then comparison is inherently accomplished without moving parts in a static relay.

A relay which was completely static would have direct and non-moving means of initiating tripping. The only way of accomplishing this hitherto has been to operate a circuit breaker trip coil through the medium of a thyratron, although there is now increasing likelihood of using a highly-rated transistor for this purpose.

Other electronic elements that are, or have been, used in experimental static relays are cold cathode tubes and thermionic valves. Families of static relays have been built in the United Kingdom and elsewhere using non-electronic means, particularly the transductor. A number of transductor relays have been very successful commercially, and some work on them still continues.

Reasons for the lack of adoption of the interesting techniques available in the early 1930's, other than in the case of carrier, are fairly obvious. Lack of standardization in the components available was contributory, but the most cogent reasons were undoubtedly lack of reliability and the complications introduced by electronic apparatus in requiring h.t. and heater supplies. Furthermore, these reasons existed in a context where the electromagnetic relay techniques in use were broadly satisfactory, or at least could be improved.

It is not easy to discuss the recent work in this field without some reference to the resurgence of interest which arose, as the war neared its end, in all forms of electronic protection other than carrier. This is because a number of the principles now in use appeared at this time. The present period is one in which the vacuum tube has no role: it is the era of the transistor, the metal rectifier, and in general terms, the semiconductor applied to relaying.

Post-War Developments

Work on electronic relays using tubes had virtually finished by 1955, according to Warrington, whereas work on transistors was well under way by 1954. During the war, great strides were made in both the techniques of electronic circuitry and in the development of valves (vacuum tubes) for many military and other purposes, and it was natural that further efforts should be made to reassess the role of electronics in producing new relays and protective gear systems. The situation was treated comprehensively by Loving, who published circuits of a novel character for many of the functions for which protective gear is required.

Clearly, electronics was in no position to displace conventional, or unconventional, electromagnetic relays, particularly where the existing systems were simple, based on modern methods of manufacture, and cheap. Room existed, nevertheless, for improvements where speed of operation, low burdens, low maintenance, reliability, and accuracy were involved. Of these five desirable general improvements, only the first two were inherently associated with the use of valves as relaying elements. This, however, oversimplified the issue.

The work during the war had brought greater reliability of components, both electronic and otherwise, and longer-life valves. On this score alone, it was thus reasonable to carry out further investigations with a view to deciding whether, or not, part of the relaying functions monopolized by electromagnetic devices could not be carried out more satisfactorily by means of electronics without compromising on any of the accepted properties. Once this point of view was accepted as a basis for further work, then the investigators could search for new properties that might advance the science of protective relaying.

From a manufacturing point of view, the marketing of relays which had very few, if any, moving parts and contacts, and had all the necessary functions such as time delay, and fault detection, or distance indication performed by electronic or other static elements, was, and is still, attractive. This type of thing can lead to welcome standardization in components and methods of manufacture, can appeal to customers for the same reason and for reasons of lower maintenance than the electromechanical counterparts. Against this, the manufacturer must weigh the considerable capital sums tied up in the existing relay manufacturing methods.

The situation is now the same as at the end of the war in that relays produced in the greatest quantities are the simplest; *e.g.* overcurrent relays. This fact is to the good since research and development can concentrate on the more complicated relays, *e.g.* distance, whose functions may be improved by the introduction of electronics and which are expensive anyway.

This is not, of course, to say that when electronic or other static relay developments are embarked upon, the simple relays will be forgotten; their situation is, however, very marginal in the opinion of this writer, unless new characteristics can be introduced.

Today, all major manufacturers appreciate the advantages of static relaying, and many of them have an eye to the use of the transistor in place of the thermionic valve. This point is well worth introducing at this stage, since it is very relevant to the situation at the end of the war. Then the disadvantages of the constructional arrangements of valves constituted the major reason for their being used in protection on an exploratory, and largely laboratory, scale only. The valve requires a heater supply and a substantial number of volts for h.t.; the transistor does not require any heater supplies and only a few volts for h.t.

This is the main reason for the attractiveness of the transistor and metal rectifier at present, and the provision of supplies the main reason for the lack of interest in the application of electronic relays ten or so years ago. In the one case of carrier, the provision of elaborate supplies has always been a worry and an embarrassment to protective gear engineers.

Types of Comparators

Theory of protective relays is truly a theory of comparison of electrical quantities. Any electromechanical or electrical component, or group of components, that is capable of comparing two or more quantities in amplitude or in phase, independently of any transient conditions, can theoretically be used as a relaying element. This point of view permits a general theory to be put forward that embraces all relaying elements.

Search can then be made for those elements that have the best or most desirable engineering quantities for a particular application: speed, accuracy, ability to withstand mechanical shock, and the like.

Relays operate when an electrical quantity in the protected circuit, usually the local current, exceeds some other quantity by a certain ratio. The comparison is made by opposing two forces, torques, mmf's or emf's proportional to the two quantities compared. The second quantity may be constant, as in the case of an overcurrent relay where a spring or gravity opposes the force produced by the current magnet. In some polyphase relaying systems, more than two quantities are compared in one element; in this case, operation occurs for a predetermined combination of input quantities.

Mathematically, the relay balances when $V_1 = KV_2\cos(\phi - \theta)$ where V_1 and V_2 are the two quantities compared, ϕ is the angle between V_1 and V_2 and θ is a preset value of ϕ which makes the right-hand side of the equation critical. If there is no phase angle involved, the relay balances when $V_1 = V_2$.

Characteristic curve on a diagram with V_1 as the reference is shown in Fig. 1, while Fig. 2 shows the characteristic if V_2 is the reference vector.

The comparison can be made in two ways: by amplitude comparison or by phase angle comparison. Either comparator can have the equation $V_1 = KV_2\cos(\phi - \theta)$. The distinction between amplitude and phase comparators is very important and

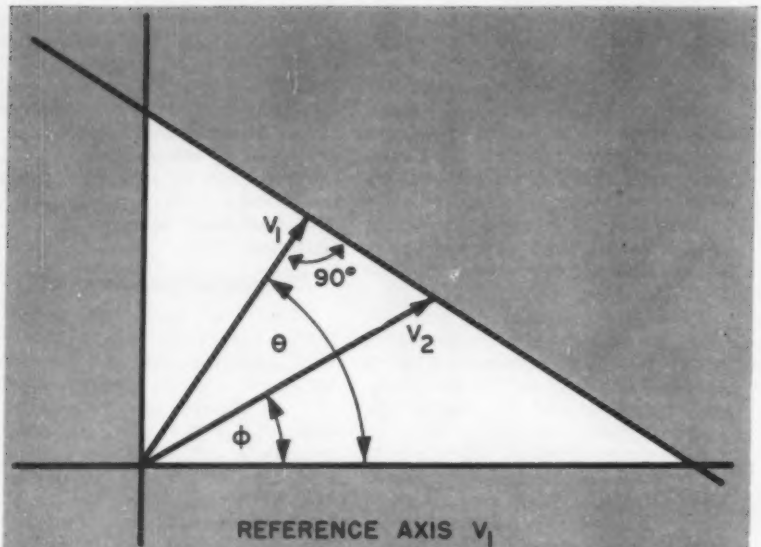


FIG 1

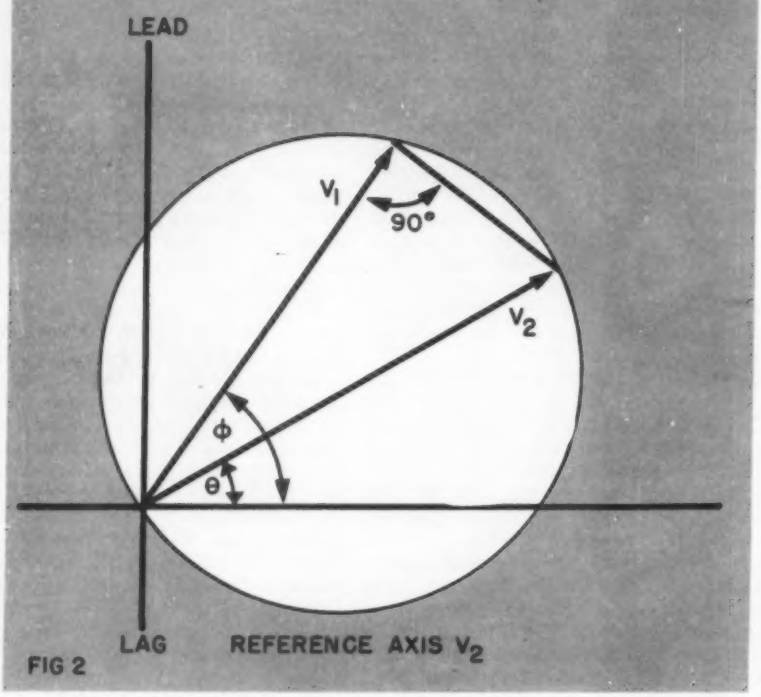
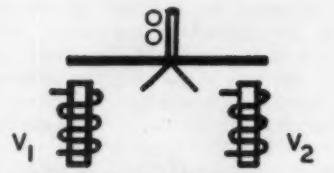
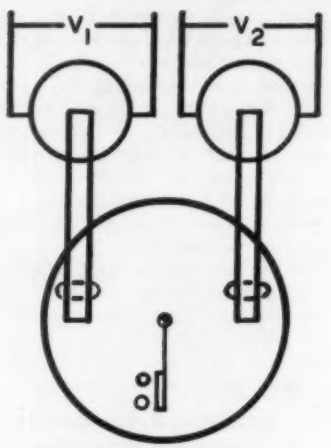


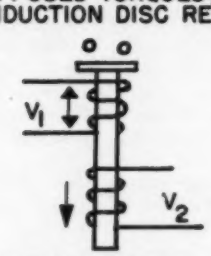
FIG 2



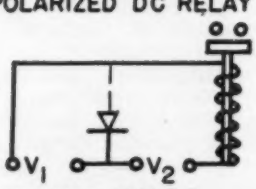
A OPPOSED FORCES, BALANCED BEAM RELAY



B OPPOSED TORQUES, INDUCTION DISC RELAY



C OPPOSED M M F S; POLARIZED DC RELAY



D OPPOSED M M F S

FIG 3
AMPLITUDE COMPARISON

Fig. 1. Characteristic of static relay with V_1 as the reference vector. Fig. 2. Characteristic of static relay with V_2 as the reference vector. Fig. 3. Drawing of types of comparators of the electrical quantities as used in relaying

has been the basis of numerous patent applications in the past.

Another way of looking at the relationship between amplitude and phase comparators is to write,

$$I_1 = I_o + I_r$$
$$I_2 = I_o - I_r$$

where I_o and I_r are the input currents into the operate and restraint circuits of an amplitude comparator, such as a simple balanced beam relay, or one of its static equivalents such as the circulating current rectifier bridge comparator to be shown as Fig. 1 in another article to follow this one. The phase comparator is generally arranged to operate when I_1 and I_2 are of the same sign; from the equations, I_1 and I_2 are of the same sign when $I_o > I_r$. Furthermore, when $I_r > I_o$ the condition for no operation, I_1 and I_2 are of opposite sign. Marginal conditions arise when I_o and I_r are equal; then I_1 is zero when they are opposite in sign and I_2 is zero when they are of the same sign.

Figure 3 shows various methods of amplitude comparison now used. The static equivalents of these will be shown in a subsequent article giving details of static relays.

MORE TO COME

Fig. 1. Charles L. Cummons, powerhouse superintendent at Dalles Dam, aboard 3-wheel, electric scooter in use there

PLANT'S SO BIG, OUR MEN NEED MOTOR SCOOTERS

IVAN J. DONALDSON, ARMY CORPS OF ENGINEERS, EXPLAINS HOW ELECTRIC SCOOTERS ARE USED TO GET AROUND FOR OPERATING AND MAINTAINING 9600-FT-LONG DALLES DAM AND POWERHOUSE

FOR THE FIRST TIME in recorded history, the flow of the Columbia River was stopped briefly, March 17, 1957, to raise the forebay level at The Dalles Dam, so that the spill could be discharged over the ogee, and to permit closure of the skeleton unit intake tubes.

On this day, operations and maintenance men learned the need for small powered conveyances to move from one end to the other of the 9600-ft structure to carry tools and make routine inspections in the many galleries and floors of the powerhouse, which is now 1400 feet long. Ultimately it will be lengthened to 2200 feet.

Superintendent of operations at The Dalles Dam discussed this need with the fisheries biologist, who for several months had been gathering information pertaining to "mountain-climbing" motor scooters.

As a result of the need for additional scooter information at The Dalles Dam, a letter was written to POWER ENGINEERING seeking data concerning small gasoline engine and electrical conveyances. This magazine aided the U. S. Army Corps of Engineers in gaining the desired material, but it was not until early in 1959 that a trio of three-wheel, electric scooters was purchased.

Those needed at The Dalles are not required to "climb trees and mountain trails" as the biologist had requested, but they do move readily in and out of the several Project elevators, through the labyrinthine inspection tunnels, galleries, and spillway and powerhouse decks.

At present, seven machines have been issued to: the roving operator, shift foreman, powerhouse superintendent, the electrical maintenance shop, mechanical maintenance shop, pipe shop, and the meter repair shop.

These machines have given highly satisfactory service. They are powered by four six-volt, lead acid, wet cell batteries connected in series. A full charge will last during an entire day's activity.

A rectifier is an integral part of the unit. The specific gravity of the batteries is checked once a month. They usually are recharged at a low amperage rate and have a seven-year life expectancy.

Electric units were selected by The Dalles Dam powerhouse superintendent because of their simplicity and because they do not produce exhaust. The fact that smooth surfaces only would be traversed was also considered in making the decision.

Operators at McNary Dam, upstream from The Dalles Dam on the Columbia River, have been using tricycles, powered by the riders, for local transportation at that plant, but electric-powered replacements are expected there soon.

Maintenance head at Bonneville Dam, who pilots his own two-wheeler about the Project, seeks several gasoline engine-powered vehicles for use by crews of men in work areas scattered over two or three miles, ranging from the north end of the spillway dam to the southwestern limits of the Bonneville Federal Housing Project. THE END

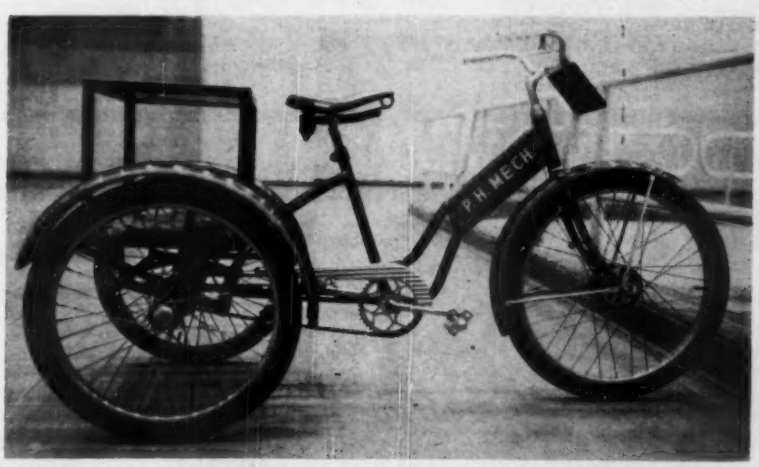


Fig. 2. Foot-powered tricycle used for local transportation at McNary Dam plant

Power Engineering HANDBOOK

Measuring Liquid Levels More Accurately

By **GORDON LENAHAN,** Engineer, Peoples Gulf Coast Pipeline Co

IT IS frequently necessary to gage levels of liquid where the head of the liquid is considerable from the point of observation. Very often, a change in level of a few feet or even inches of head should be measurable. This is difficult with an ordinary pressure gage.

I have found an old method, seldom used, very helpful. In a typical example of an elevated water storage tank, accuracy can be increased tenfold using existing piping with very minor modifications.

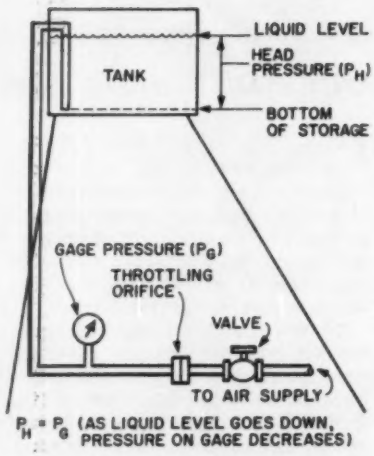
First, a gage line must be run to the top of the tank and then extended to the bottom of storage. A trickle of instrument air through a suitable orifice arrangement, allowing an occasional bubble of air to come from the open end of this gage line into the tank at all times, is all that is necessary. A low-scale gage, calibrated in feet of head, reads the feet of water above the end of the line in the tank.

An arrangement of this sort can easily distinguish as little as a 2-in. change in water level 100 ft in the air or below the ground.

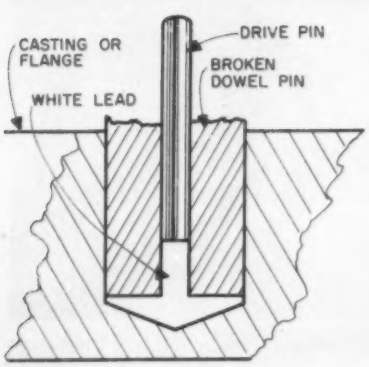
Several precautions are necessary for the long-term application of this method. All lines involved must start out dry and stay dry. This is ordinarily no problem.

Also, the trickle of air must be small and constant for a successful, permanent installation. There are many ways of accomplishing this, depending on the individual installation, but an orifice of some kind is essential. A sight feed, partially filled with oil or glycerine, located near the gage, is helpful in checking continuity of air flow. Without a constant bleed, a percentage of air trapped in the line would bubble out, and the gage would not read properly when the liquid level rose in the supply tank. Actually, the requirement is that air bubble, or be able to bubble from the end of the tubing at the time of a reading.

For a portable hookup, I have often used a fire pump and whatever gages or manometers were available, coupled to a length of copper tubing.



The principle involved is simple. Air pressure increases until the first bubble of air leaves the open end of the tubing. At that time the pressure of the air equals the feet of head of the liquid. As long as the air flow is insufficient to cause pressure drop in the line, the pressure at any point in the line equals the feet of head above the end of the tubing.



How to Remove That Broken Dowel Pin

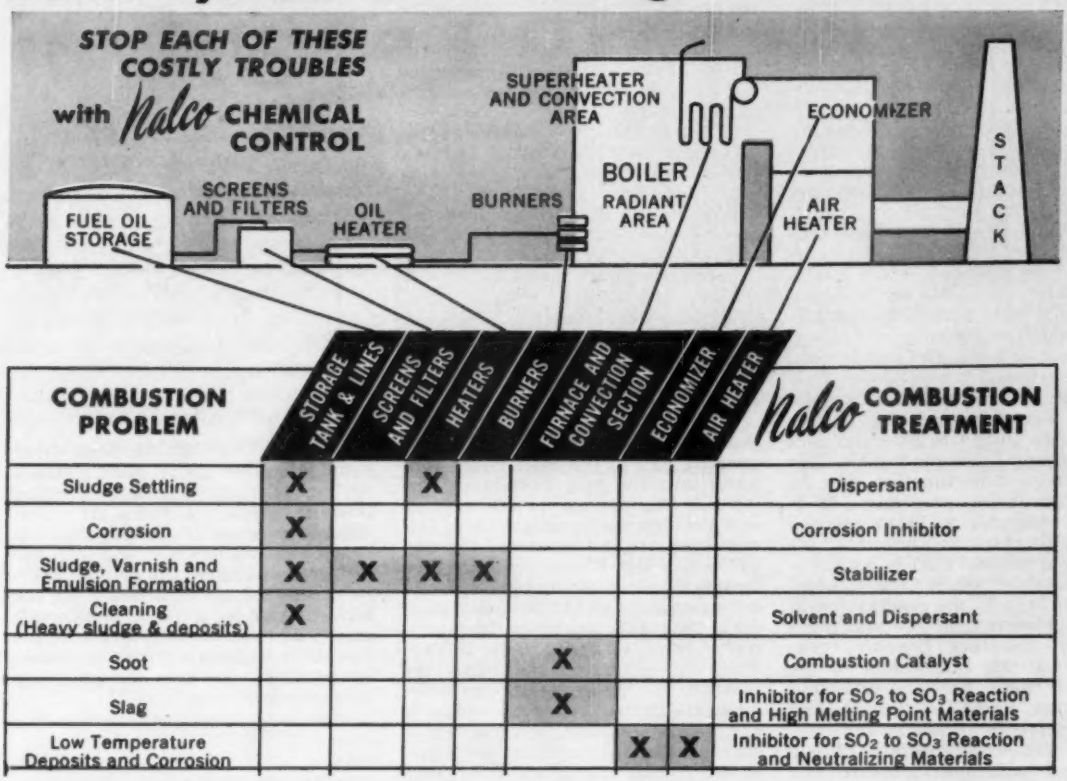
By **JAMES J. FISCHER,** Westinghouse Electric Corp

FROM TIME TO TIME we have occasion to remove broken dowels or a pin that has been driven too deep by mistake. To do this we use the method shown in the sketch, which works very well indeed.

Drill a hole of suitable size in center of the broken dowel. Pack the hole partly full of white lead, and then insert a snug-fitting pin down into the hole.

A sharp blow on drive pin with a hammer will drive white lead into recess under the dowel, setting up hydraulic pressure and so raising the dowel.

Nalco Residual Fuel Oil Treatments Protect Boiler Systems from Storage to Stack



Low-cost fuel oil will not become an expensive cause of power plant maintenance and replacement costs when you put Nalco treatments to work controlling sludge, deposits, corrosion, soot, slag or acid formation. There is a Nalco treatment for each of these specialized jobs . . . to provide you with effective protection from storage to stack.

Pre-Flame System

Storage tanks and the pre-flame fuel system can be kept deposit- and corrosion-free with Nalco sludge dispersants, corrosion inhibitors and stabilizing treatments. Where sludge deposits have built up in tanks, there are Nalco treatments that will disperse them into usable fuel and recover lost storage space. Stabilizers and dispersants assure better burning by preventing fouling of burners by varnish or sludge.

Furnace and Convection Area

Soot and slag deposits are common troubles caused by untreated residual fuel oils. There is a Nalco treatment for control of each of them . . . to substantially boost efficiency and reduce mechanical cleaning costs. Combustion catalyst type treatments lower soot ignition temperatures . . . assure more complete combustion, cleaner burning. Slag deposits are substantially reduced by additives that modify the high temperature chemical reactions of ash and sulfur in the oil.

Economizer and Air Heater Sections

Keeping corrosion and acidic deposits out of economizers and air heaters was often the most difficult part of plant combustion problems to solve economically—until Nalco developed successful "cold-end" treatments. Inhibitor-neutralizers modify the chemical reactions which convert sulfur dioxide to the sulfur trioxide that creates corrosive conditions in low temperature areas.

Long Range Economy

Residual fuel oils, *plus Nalco fuel oil treatments*, can build a very attractive operating-cost picture in your plant. For a flying start toward long-range fuel economy, call your Nalco Representative today, or write us for details on *specific* Nalco answers to your combustion problems.

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Determining Generator Gas Leakage Rapidly

By **EDWARD SWITOW**, Engineer, Louisville Gas & Electric Co

IN PRESENT-DAY large hydrogen gas-filled generators, it is important that the hydrogen leakage through joints and seals be held to a minimum. This strict low leakage requirement as specified by the manufacturer is absolutely necessary to prevent a possible serious explosion and to minimize gas consumption.

Following a major turbine-generator inspection where the generator field has been removed, many joints, piping, and valves have been removed and reassembled, so the possibility for imperfect joints and piping connections is wide. Before the generator is released for operation it is important to know the exact leakage in cubic feet of gas per day that is taking place from the generator and accompanying hydrogen piping. This final leakage determination can be a time-consuming procedure. It is therefore desirable to use a method that is both quick and accurate. We are using a method that is both.

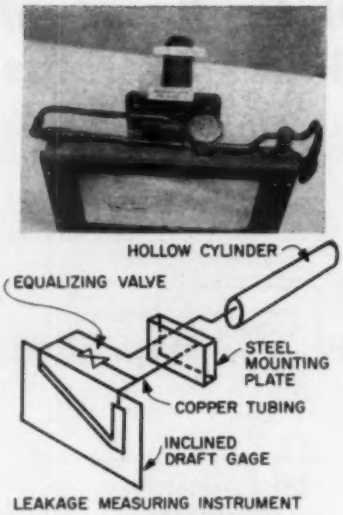
One method which many companies use is to fill the generator with air at a pressure near the maximum hydrogen operating pressure, connect an accurate manometer to the generator, read the pressure and temperature, wait 12 or 24 hours, and again observe the pressure and temperature inside the generator. Using the initial and final pressure and temperature, it is possible to calculate the leakage for the duration of the test. However, in the calculations, the difference in temperature at the beginning and end of test is critical. Most generator station temperature-reading instruments recording in Centigrade make this important measurement too inaccurate to use; hence it is desirable to use a leak determination method that will eliminate the variable of temperature change during the test.

Shown in the accompanying photograph and sketch is a test instrument that will give results quickly, can be fabricated from stock instruments, and eliminates the temperature variation factor. Parts needed to construct the panel are: an inclined gage, one refrigeration-type valve, copper tubing, hollow steel cylinder, and steel plate for mounting. The steel mounting plate can be drilled and tapped to fit an accessible inspection window or port of the particular generator to be tested.

Principle of operation is simple and can be explained as follows: High-pressure side of the manometer connects into the hollow cylinder, the low side from the manometer extends just through the mounting plate. Air admitted into the generator fills and surrounds the hollow cylinder, the temperature of air in the cylinder being the same as the temperature of air in the generator. When the instrument valve is closed, any leakage from the generator will cause the pressure in the generator to drop. Since the initial pressure is locked in the hollow cylinder, the amount of leakage can immediately be determined by the rate of fall of liquid in the inclined gage.

When generator and piping have been reassembled, seal oil system is in operation, generator may be tested for leakage as follows:

Remove the inspection port and mount the instrument with the hollow cylinder inside the generator. With the instrument equalizing valve



LEAKAGE MEASURING INSTRUMENT

open, admit air that has been dried through a silica gel or other suitable drying agent until desired testing pressure is reached. Close air valve. After waiting a short period, close the instrument valve which will trap the test pressure inside the cylinder. Observe the change in pressure on the inclined gage for a period of approximately 15 minutes. It is now a simple procedure to calculate the exact leakage of air per day from the generator using the following formula:

$$L = V \times \frac{P1 \times 0.036}{P} \times \frac{24}{T}$$

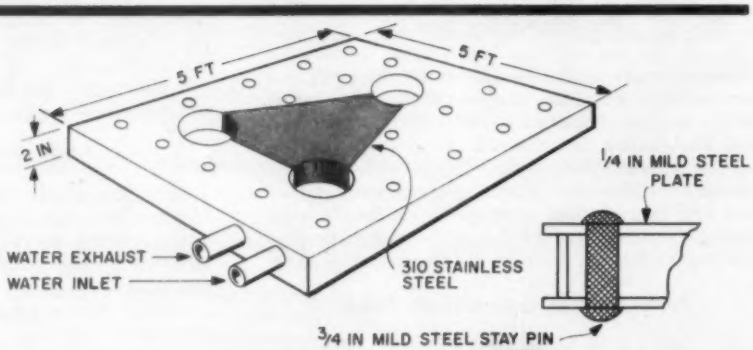
Where:
L = Leakage in cubic feet per day
V = Volume of generator in cubic feet
P1 = Loss of pressure as read on inclined gage in inches of water
P = Test pressure in psi
T = Duration of test expressed in hours

By this method of rapidly determining the amount of leakage, the necessary corrections can be made immediately.

Water-Cooled Smog Roof Cuts Downtime On Electric Furnace

By **D. K. SMITH**, Maintenance Foreman Southwest Steel Rolling Mills, Los Angeles

BEFORE we designed and built a water-cooled smog roof for our 16-ton electric furnace, we averaged about 20 hours a week downtime on 3-turn operation, due to the center section burning out on duct work. First roof only lasted six weeks before we had downtime, even with water cooling. We found that the center section had burned out due to induction heating caused by separating electrodes with ferrous metal.

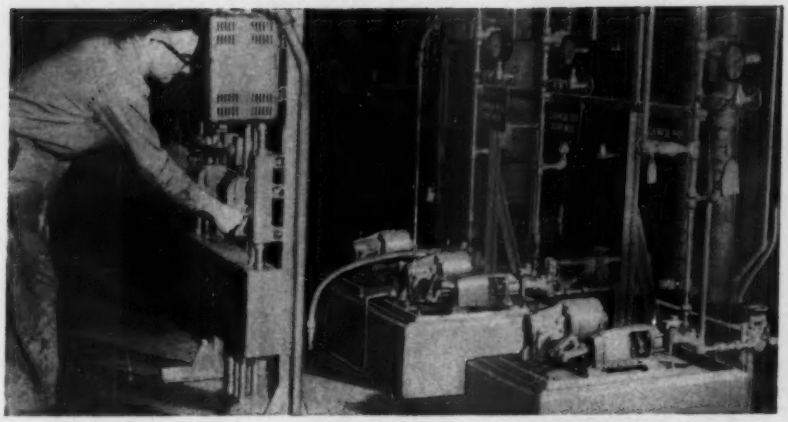


Next step was to install 310-stainless steel center section, as shown by the blacked-out section in the sketch. We now average one year of service before repairs are necessary.

Power Engineering HANDBOOK

how to select the right metering pump for water treatment

SOFTENING, demineralizing, pH control, oxygen scavenging . . . all of the treatments commonly applied to water place special demands on chemical feed systems. Chemicals must be metered to a high degree of accuracy, but many of them, particularly the strong acids and alkalies, are themselves highly corrosive. Through the years, controlled volume pumps have proved the ideal metering technique in this field, combining accuracy, controllability, and corrosion resistance. But the question often arises, "Which controlled volume pump design is best for my water treatment needs?" Here are a few practical suggestions based on actual experience.



Standard Milton Roy MD pumps meter ammonium hydroxide to maintain desired boiler feedwater pH at Ohio Power Company. Milton Roy miniPumps also feed minute amounts of hydrazine to remove residual oxygen from feedwater at this generating station.

PUMP SELECTION GUIDE

FOR	USE THIS PUMP TYPE
Coagulation	
alum	MD
silicate	MD
Demineralization	
acid regeneration	Diaphragm / Mersemetric
alkali regeneration	Diaphragm
Softening	
conc. phosphoric acid	Diaphragm
conc. sulfuric acid	Diaphragm / Mersemetric
lime slurries	MD
phosphates	MD / H20
soda ash solution	MD
Oxygen Scavenging (Boiler Water)	
sodium sulfite	MD / H20
hydrazine	MD / miniPump
Calcium Precipitation (Boiler Water)	
phosphates	MD / H20
Carbon Dioxide (Boiler Water)	
neutralizing amines	MD / H20
filming amines	MD / H20
pH Control (Boiler Water, Process Water, Cooling Towers)	
caustic soda	Diaphragm / Mersemetric
sulfuric acid	Diaphragm / Mersemetric

Packed plunger pumps . . . MD, H20®, miniPump®

The standard Milton Roy MD pump is usually the first choice for metering water treatment chemicals. Highly accurate, its capacity is readily varied manually or automatically in response to treatment demands. A wide variety of materials of construction from cast iron to stainless steel withstand all mildly corrosive treatment chemicals. Capacities to 2056 gph, pressures to 1000 psi. *Bulletin 553-1.*

Non-corrosive chemicals can be metered economically with the H20 pump if constant speed operation is satisfactory. Though it cannot be adjusted in operation, this low cost pump is ideal for feed to packaged boilers. Capacities to 28 gph, pressures to 600 psi. *Bulletin 558-3.*

When extremely small volumes of chemical, from 20 to 2940 milliliters per hour, must be metered to accuracies of 1%, the Milton Roy miniPump is the right answer. That's why this design is just about standard for metering hydrazine in oxygen scavenging. Pressures to 1000 psi. *Bulletin 1257-2.*

Diaphragm liquid ends

The best pump for highly corrosive or otherwise dangerous treatment chemicals is the diaphragm pump, with a stainless steel or plastic diaphragm isolating the plunger from the treatment chemical. Positive air purging at each stroke eliminates any chance of air binding. And the diaphragm liquid end is readily interchangeable with the packed plunger liquid end of the standard MD pump, permitting economical modernization in the event of a change in metering requirements. Capacities to 400 gph, pressures to 2700 psi. *Bulletin 1157-2.*

Totally immersed liquid ends . . . Mersemetric®

Many special metering problems are easily solved by Mersemetric controlled volume pumps with the liquid end submerged to a depth of up to fourteen feet. Chemicals can be metered directly from storage tanks without any need for tank connections below liquid level. Mersemetric pumps are widely used to feed sulfuric acid to cooling tower water and deaerator effluent, and sulfuric acid or caustic soda for demineralizer regeneration. Capacities to 218 gph, pressures to 1200 psi. *Bulletin 1153C.*

If precision pumping of boiler water treatment chemicals is one of your problems, look again to Milton Roy's 25 years of experience for your most economical solution. Milton Roy Company, 1300 East Mermaid Lane, Philadelphia 18, Pennsylvania.

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CHEMICAL INSTRUMENTATION SYSTEMS

Controlled Volume Pumps • Quantichem Analyzers
Chemical Feed Systems • pH Instruments

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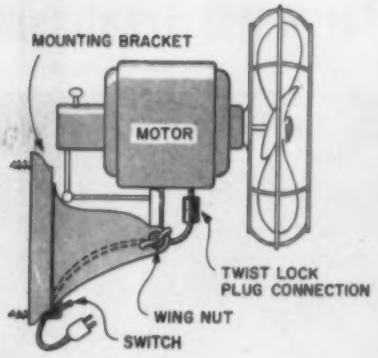

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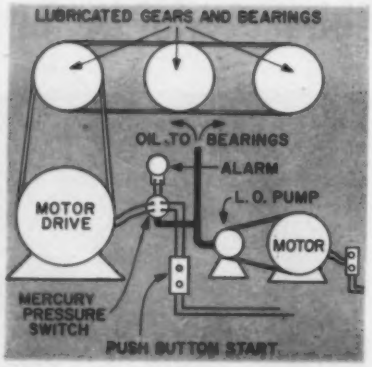

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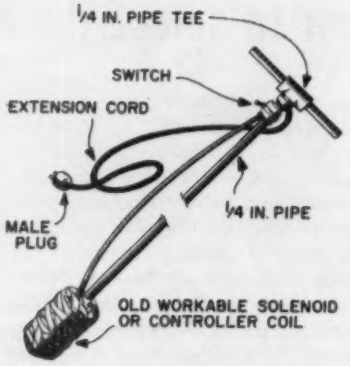

3

Use a Little Imagineering

By TOM MULLIN

1. Speeding repair of fan motor

Every time we had to replace coils in fan motors, or renew bearings, oscillating gears, condensers, etc, we had to take the fan off the wall, dismantle the mounting bracket, switch and connecting wires. To cut down on the time required for such a job, we installed a twist lock type of connector plug, as shown in Fig. 1. Now all we have to do is unscrew the wing nut, break the twist lock plug connection, then make the repairs; it isn't necessary to take the fan off the wall.

2. Safeguarding lube oil system

Our kiln has rollers and gears that are pressure lubricated. Because of the high temperatures, we were concerned about failure of our lube oil system. We hooked up a pressure switch on the lube oil pump, plus an alarm (Fig. 2). If our pressure fails, gear motor stops and the alarm sounds, preventing gears and roller bearings in the kiln from burning out.

3. Tool pick-up

Figure 3 shows a handy device for picking up tools which have fallen below the floor plates, or are in other hard-to-reach places. It's made from ¼-in. pipe, wire and a solenoid coil or controller coil. For flexibility, rope could be used instead of the pipe. Use waterproof tape in taping up the coil and make sure connections are well insulated.

Some Questions and Questionable Answers for Heating Engineers

By WILLIE HAMMER, P. E.

Q. What is a British Thermal Unit?

A. An English boiler plant.

Q. I live in International Falls, Minn, where the temperature in winter sometimes drops to minus 55 F. Can you offer any suggestions on how I can reduce my fuel bills to a minimum?

A. Yes. Move to Hawaii.

Q. What is a degree-day?

A. Commencement at a university.

Q. What is entropy?

A. When the available energy in a system decreases, entropy increases. Thus, on a Sunday morning after a hard Saturday night out with the boys, you may have no available energy but lots of entropy.

Q. What is a T-s diagram?

A. As any present or former member of the Armed Forces knows, T-s means "tough situation." However, some engineers are not too bright and a picture has to be drawn to illustrate what the situation actually is. This is known as a T-s diagram.

Q. When do we have a change of state?

A. After every revolution in Latin America or the Middle East.

Q. What is a change of phase?

A. A woman applying makeup.

Q. What is the law of conservation of energy?

A. If the thought of work occurs, lie down until it goes away. Especially on a warm, sunny day.

Q. What is work?

A. Anything you're not in a mood to do.

Q. I am a trainee in a boiler plant run by an engineer who seems to be a practical joker. During the past month I was cleaning the inside of a boiler drum, when he hit the outside with a sledge hammer causing the drum and my head to reverberate. He then opened a cold water valve, getting me all wet. He started the chain grate stoker running at full speed when I was cleaning the furnace walls, making me run as on a treadmill until I fell into the ashpit. I'm beginning to get the impression he's not a very civil engineer. What do you think?

A. As everyone knows, there is no such thing as a civil engineer. They're all mean, ornery, lowdown characters. This one seems to be more of a chemical engineer.

Q. What is the saturated liquid line?

A. The chalk line for sobriety tests. If you can't walk it, you're saturated.

Q. What does a Mollier chart show?

A. Molliers.

Q. How many Btu in a horsepower?

A. What size horse? One has 2545 and the other 33,475 Btu per hour.

Q. Why is bituminous coal better for combustion than wood?

A. Bituminous coal was formed millions of years ago and wood only recently; and as everybody knows, there's no fuel like an old fuel.

Q. What is throttling?

A. Justifiable action taken to silence the authors of corny jokes.

Power Engineering HANDBOOK

BEACON COALS FOR ELECTRIC UTILITIES, Industrial and Commercial Uses

Here are some facts that may interest you — as a buyer of coal for power plant use — when you are seeking a dependable source of supply.

Our yearly productive capacity is in excess of 10,000,000 tons. We can meet tonnage requirements of the largest user, and adhere to the strictest time-table on shipments.

We produce, in our fifteen active mines, a variety of coals with a complete range of analyses. We can thus satisfy the most exacting specifications . . . and furnish the fuel best suited to your particular combustion equipment.

We maintain a central coal laboratory, supplemented by quality control labs at each of our larger mines. This assures conformity to standards.

Our representatives are trained combustion men, who can understand your needs, and work intelligently to meet them. Inquiries and follow-ups are expedited by our teletype network, which connects sales offices with all our major mines.

Doesn't it seem reasonable to think that our *product* plus our *service* can bring you something extra in filling your fuel needs? We'd like to demonstrate that it can.

EASTERN GAS AND FUEL ASSOCIATES

EASTERN GAS AND FUEL ASSOCIATES

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For Export: CASTNER, CURRAN & BULLITT, INC.

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CONSTRUCTION NEWS

San Francisco, Calif. — Pacific Gas & Electric Co, 245 Market St, has plans under consideration for major expansion of its Morro Bay Power Plant, located in San Luis Obispo County. Work will include installation of a steam-electric generating unit with high-pressure boilers and auxiliary equipment which will have an initial capacity of 325,000 kw. Work is planned for early 1961, and unit is scheduled for completion by late 1963 at a cost estimated around $40,000,000.

Dongola, Ill. — Southern Illinois Power Cooperative, this city, has authorized plans and will build a 354-mile, 69,000-v transmission line from its generating station located at Marion, Ill, to connect with the distribution system of Egyptian Electric Cooperative Assn, Steelville, Ill. Cost upon completion in about eighteen months will reportedly be over $4,500,000.

Lemont, Ill. —Commonwealth Edison Co, 72 W. Adams St, Chicago, Ill., has authorized plans and work has begun on the installation of a 20-story, 3,000,000-lb-per-hr steam generating unit at company's Will County Power Station, near here. Contract award for the project has been awarded to the Combustion Engineering Co, 200 Madison Ave, New York, N. Y. Work is scheduled for completion by the summer of 1962.

Hammond, Ind. — Northern Indiana Public Service Co, 5265 Hohman St, has announced plans to construct a new power plant in Burns Harbor, Porter County, on Lake Michigan, near here. Initial work will include installation of a steam-electric generating unit, high-pressure boilers and auxiliary equipment at a cost estimated to be $30,000,000. Work will begin at once and plant will be completed by the spring of 1963. Sargent & Lundy, Chicago, Ill, is the consulting engineer.

Ashland, Ky. — Kentucky Power Co, Fifteenth St and Carter Ave, has announced contract award of $39,000,000 to the Westinghouse Electric Corp, Pittsburgh, Penna, for the construction and installation of a steam-electric turbine generator which will have an initial capacity of 265,000 kw in company's new plant now under construction at Louisa, Ky. Contract for the 150-ft-high steam boiler and auxiliary equipment for the Big Sandy Power Station was awarded to the Babcock & Wilcox Co, New York, N. Y. Work has begun and is scheduled for completion the early part of 1963.

Paradise, Ky. — Tennessee Valley Authority, New Sprankles Bldg, Knoxville, Tenn, has authorized plans for the second installation of a 650,000-kw steam-electric generator, boosting projected capacity for the Paradise Steam Plant to 1,300,000 kw. General Electric Co will supply the second generator at a total cost of $16,250,000; Babcock & Wilcox, the boiler and auxiliary equipment for the turbine-generator; and Ingalls Iron Works Co, the structural steel for the unit at a cost of $2,314,365. Boiler installation was reported to cost approximately $13,850,000, for a total investment of over $32,400,000.

New Orleans, La. — Louisiana State University, Board of Trustees, has authorized contract award to the Plant Service Corp, Baton Rouge, La, for a central generating plant including a mechanical and electrical distribution system for the Louisiana State University. Work is already under way and is scheduled to be completed late next year at a cost of $974,828.

Dickerson, Md. — Potomac Electric Power Co, 929 E. St, N.W., Washington, D. C., has announced contract award to the Bechtel Corp, 220 Bush St, San Francisco, Calif, for the design and construction of Unit No. 3 at company's Dickerson Power Station, located here. Work is scheduled for completion by the fall of 1961.

Minneapolis, Minn. — Northern States Power Co, 15 S. Fifth St, has authorized plans for the expenditure of an average $1,000,000 per week on construction of a $24,000,000 addition to company's Black Dog Power Station near here and a $4,800,000 start on a major construction program on an atomic-powered plant near Sioux Falls, S. D. Outlay for the year is estimated at about $56,000,000 and is part of a three-year program with a total investment of $141,000,000.

Rochester, Minn. — City of Rochester, Municipal Utilities Commission, has authorized extensions and improvements to municipal power plant to include installation of a new steam-electric generating unit with an initial capacity of 22,000 kw. Contract award for the new unit was given to the Westinghouse Electric Corp, 2303 Kennedy St, N.E., Minneapolis, in the amount of $1,030,000. Work has begun and is scheduled to be completed by the fall of 1961.

Utica, N. Y. — Niagara-Mohawk Power Co, 300 Erie Blvd, Syracuse, N. Y., has announced contract award of $5,000,000 to the Buffalo Electric Co, 75 W. Mohawk St, Buffalo, N. Y., for installation of 345,000-v and 115-v outdoor switchyard transformers, including installation of oil circuit breakers in connection with the company's sub-station now under construction at Utica, N. Y. Work is progressing according to schedule and will be completed by the spring of 1962.

Gaston, N. C. — Virginia Electric & Power Co, Seventh & Franklin sts, Richmond, Va, has authorized plans and will start construction at once on its hydroelectric dam and power project on the Roanoke River, near here. Plans call for the installation of four generating units, each with a capacity of 50,000 kw. Completion is scheduled for late 1963 and will represent an investment of $50,000,000.

Eugene, Ore. — Eugene Water & Electric Board, has plans under way on the construction of a hydroelectric dam and power station which will have a capability of 90,000 kw. Work on the new facility, to be known as the Carmen-Smith Hydroelectric project, has begun under the supervision of the Bechtel Corp, San Francisco, Calif. Plant will be completed in the fall of 1962 at a cost approximating $26,000,000.

Portland, Ore. — Pacific Power & Light Co, Public Service Bldg, has authorized plans for the testing of coal from untapped fields in southwestern Oregon for possible use as a raw material for industrial by-products. Utility has leased 880 acres of mining rights in the Eden Ridge coal field, 50 miles southeast of Coos Bay, Ore, as fuel source for a future 100,000-kw steam generating plant, which it plans for this area. Company hopes to be able to burn the combustible part of the coal at the plant and use the rest for by-products. Colorado School of Mines, Golden, Colo, will run tests on 60 tons of coal mined in this area.

Philadelphia, Pa. — The Board of Trustees of Temple University, 1900 Park Ave, has authorized plans and work is already under way on the construction of a large new chemistry building on Temple University Campus. Building is expected to be completed sometime in the spring of 1962. In conjunction with the new project, plans also include the installation of a new power plant at the facility at a cost over $500,000 of a reported total outlay for the entire project of better than $5,550,000.

Bristol, Tenn. — Bristol Power Board has authorized plans to install underground power lines throughout this city. Work, reported to cost approximately $1,150,000 for the initial stage, will begin soon and will be completed by the spring of 1962. E. Barrett Foster, Sheffield, Ala, is consulting engineer for this phase of the installation.

Jefferson, Texas —Southwestern Electric Power Co, 428 Travis St, Shreveport, La, has authorized plans and will begin construction at once of a new power plant to be located approximately 15 miles northwest of this city. Work will include installation of Unit No. 1, with an initial capacity of 186,000 kw, reported to cost over $15,000,000. Plans also include installation of electric transmission lines at a cost of $300,000, a machine shop at $125,000, and outside water lines, reported to cost approximately $75,000. Plant is scheduled to be in operation by the fall of 1962.

San Antonio, Texas — City Public Service Board of the City of San Antonio, 145 Navarro St, has work under way on a major expansion and improvement program on the municipal power plant here. Work is to include installation of a new steam-electric generator for increased capacity, along with the installation of electric power transmission lines. Work already under way is scheduled for completion by the spring of 1962. Cost of project is reported to be about $20,000,000.

Marshfield, Wis. — Marshfield Electric & Water Dept, City Hall, this city, will have plans prepared soon for extensions and improvements to municipal steam-electric power plant, with installation of equipment for increased capacity. Total cost of expansion and improvement program is reportedly over $2,000,000. Benjamin, Woodhouse & Guenther, Detroit, Mich, is the consulting engineer. Work will begin soon for completion by late next year.

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New Engineering Books

Teamwork in Technology — Managing Technician Manpower, by various authors of Graduate School of Business Administration, Harvard University; 176 pages, typewritten and planographed, 8½ by 11 in.; paper cover. Published by Technician Manpower Associates, Box 158, Scarsdale, N. Y. Price, $18.50.

Alarm raised in recent years about the shortage of engineers and scientists has until very recently drowned out the voices of those who have seen well-trained technicians as part of the answer to such a shortage, assuming that it exists.

How technicians can help to relieve the pressures on engineers and scientists is a question that is only now being studied. To help in resolving this question and aid the administration of a really new group in the industrial family, this book should be of much value to engineers, to technicians, and to management.

Its major purpose is to clarify and relate the factors that should bear on a company's development of a policy for managing its technician group more effectively. It is based on a survey of more than 80 corporations and many educators, government officials, union leaders, and technicians, themselves.

The book begins by proposing a basic definition of the term technician. It goes on to describe how technicians are found, hired, trained, and supervised. It compares the technician's concept of his role with that of management, and there are interesting data on the role of government in training and using technicians.

It should be noted that the professional engineering societies themselves are doing a good deal of work in trying to clarify the definitions of professional engineer and technician, and this report should be of interest and value to all members of those societies. The power engineer whose organization includes technicians could very well recommend this book to the management of his company.

★ ★ ★

A Source Book in Mathematics (Vols. 1 and 2), by David Eugene Smith; 701 total pages, 5⅜ by 8 in.; paper cover. Published by Dover Publications, Inc, 180 Varick St, New York 14, N. Y. Price, boxed set, $3.50.

Here are two volumes which can be read for sheer enjoyment. Published originally as a one-volume hard cover edition in 1929, this entire study is now available for popular consumption at only $1.85 per copy.

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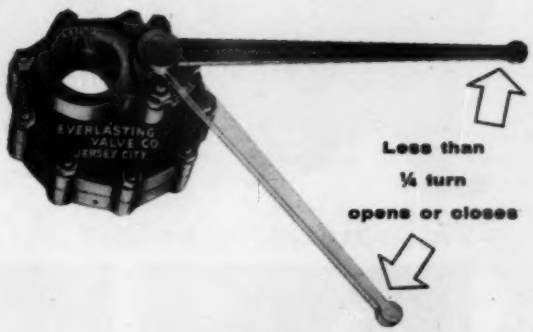

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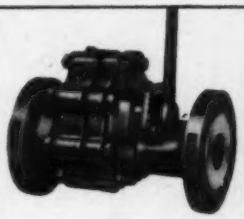

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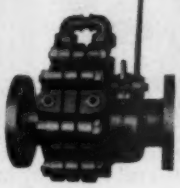

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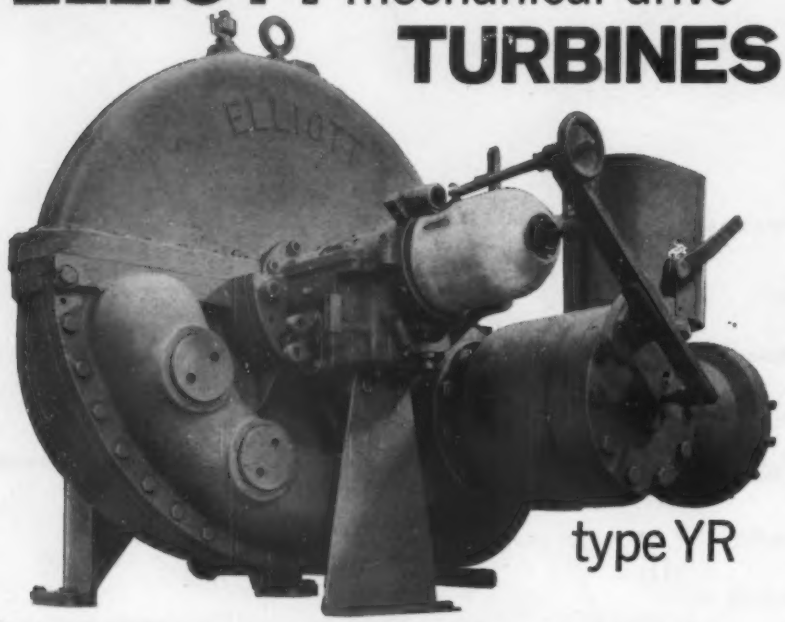

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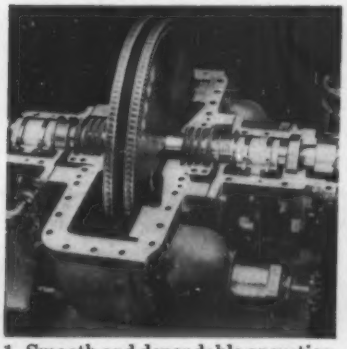

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This unique anthology can be enjoyed by anyone who deals with or has ever dealt with mathematics — and that means everyone.

★ ★ ★

Elementary Engineering Mechanics, by Eugene George Key; 457 pages, 6 by 9¼ in. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y. Price $5.50.

Designed specifically for two-year technician programs, this book fully describes all the essential elements of statics and dynamics and their application to engineering problems. The author begins by introducing statics or stationary bodies, and then treats dynamics or moving bodies. Correct analysis, the author shows, can solve even the most complicated mechanics problems. The study is further simplified because only a basic background in algebra and plane geometry is required, plus an ability to learn trigonometry from the explanations given by Mr. Key.

Here are a few of the special features offered: A different, simplified approach to explain nonconcurrent noncoplanar nonparallel force systems; comprehensive description of static and kinetic friction; a pinpointing and analysis of engineering principles to simplify any task of analyzing either a theoretical or actual force system.

★ ★ ★

The Oil Engine World Directory of Manufacturers, 116 pages; 5 by 7 in.; paper binding; published 1960 by Temple Press, Ltd, Bowling Green Lane, London EC 1, England. Price 7s/6d, or $1.42.

This directory is published under the

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auspices of the *Oil Engine and Gas Turbine* magazine, an English publication, and was compiled by the editor of that magazine, D. S. Dodsley Williams. Because of the growing importance of the diesel engine in all parts of the world, users of these engines and all those connected with their manufacture and design need concise information about the ranges of capacities offered by the manufacturers in many countries.

The information is arranged under the headings of the separate companies and gives the name of each manufacturer with a list of the types of engines he manufactures for industrial, railway, marine and transport service — together with the number of cylinders and the horsepower ranges of each type produced.

★ ★ ★

Mathematical Methods for Digital Computers, edited by Anthony Ralston and Herbert S. Wilf; 293 pages; illustrated; 7¼ by 10½ in.; cloth binding; 1960. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, New York.

Readers of POWER ENGINEERING and particularly of the Special Section on Automation in the Power Field in the January, 1960 issue, must be fully aware that the introduction of computers into the control systems of power plants and complete power systems is proceeding rapidly and is one of the outstanding present developments in the field. For that reason, more and more power engineers in the future are going to have to deal with them. Those who do will find this book a very valuable one.

There are many books on computers and programming and also on the subject of numerical analysis. This book, however, offers a unified and integrated treatment of both subjects. In other words, it not only describes the mathematics that must be used in putting programs into digital computers, but it tells in much detail just how it is done.

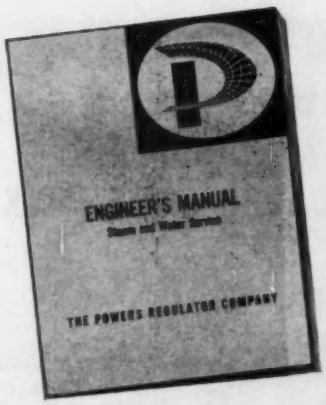
A group of 28 experts in programming and applied mathematics have contributed articles to this book. They cover such subjects as: The Generation of Elementary Functions; Matrices and Linear Equations; Ordinary Differential Equations; Partial Differential Equations; Statistics; and Miscellaneous Methods.

Each chapter affords a thorough mathematical treatment of a given method and a detailed account of its reduction to digital computer terms. It gives calculation procedures, flow charts, sample problems, memory requirements, estimates of running time, and so on. Actual coding is omitted because that would involve reference to particular types and makes of machines.

It is claimed that this is the first book to show the relations between these mathematical analyses and the actual processing by the computer. As such, it should prove most valuable to power engineers.

★ ★ ★

Design of Small Dams, edited by members of Bureau of Reclamation, U. S. Dept. of the Interior; 611 pages, 8 by 10½ in.



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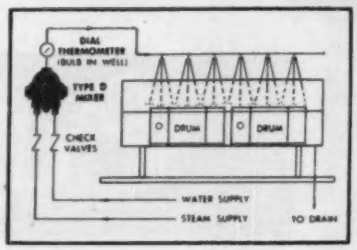

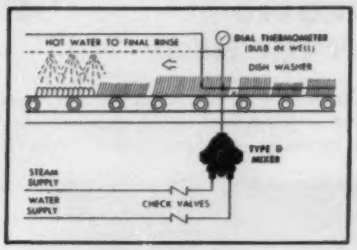

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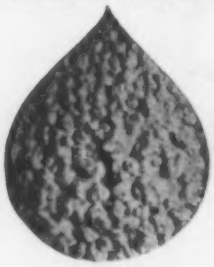

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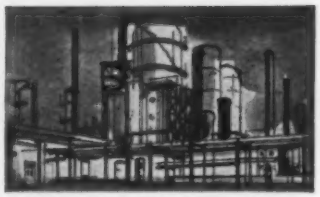

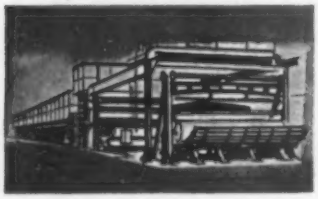

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Published by U. S. Government Printing Office. Price, $6.50. Address for copies: U. S. Superintendent of Documents, Washington 25, D. C.

Design of Small Dams is a guide to small water resource organizations, public agencies, and private engineers engaged in the design and construction of small dams and retention reservoirs.

Eleven chapters discuss project planning, flood studies, selection of type of dam, foundations and construction materials, earthfill dams, rockfill dams, concrete gravity dams, spillways, outlet works, diversion during construction, and maintenance and operation. This listing, which excludes more-detailed sub-listings, typifies the wide scope of the new work.

Seven appendices list, among other things, hydraulic computations, structural design data, and sample specifications.

A total of 331 illustrations and engineering plates help further to clarify this study. The Bureau of Reclamation has been engaged in dam design for fifty years, a length of time which has gained for it a high degree of recognition. Over the years, the Bureau has heard an ever-increasing demand from the public for technical assistance by its staff in planning for and design of small dams.

Bureau Commissioner Floyd E. Dominy prefaces the work by outlining its threefold purpose: 1. It will provide engineers with information and data necessary for the proper design of small dams; 2. it will provide specialized and highly technical knowledge concerning the design of small dams in a form that can be used readily by engineers who do not specialize in this field; and 3. it will simplify design procedures for small earthfill dams.

★ ★ ★

Report on Stress Corrosion Cracking of Austenitic Chromium-Nickel Stainless Steels — STP 264; 96 pages; paper cover; size 8½ by 11 in.; published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania. Price $6.00 (to members, $4.80).

When certain compositions of stainless steel are exposed in particular corrosive environments, and simultaneously are under stress due to previous cold working or service loads, spontaneous cracking may occur. The problems associated with stress-corrosion cracking are influenced by numerous conditions. This report, sponsored jointly by ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys and Committee T-5E of the National Association of Corrosion Engineers, includes information gathered through an extensive international survey covering 145 case histories from the United States and England.

The volume is divided into 2 parts and an appendix. Part 1 is a review of the case histories; Part 2 covers present status of research work. Extensive tabulated data of the case histories, and a well-annotated bibliography covering references up to June, 1959, may be found in the appendix.

Will the Hot Air Engine Come Back?

PERHAPS IT WILL, for a number of applications, if the General Motors Research Laboratories has anything to say about it. That organization plans to introduce the modern Stirling thermal engine, a name for what is usually called the "hot air engine," to the engineers of America. They state that this engine has recently become an efficient, practical machine with some noteworthy and unique characteristics.

The principles of the Stirling engine are not new. They have been known for more than a century, having been first propounded by Reverend Henry Wood in 1759 and later being developed by Robert Stirling in England in 1816. The term "air engine" refers to a reciprocating heat engine that compresses cool air and expands heated air to drive a piston and develop useful power.

General Motors' Research Laboratories' study of the Stirling engine is not new; it has continued for more than a decade. But work on the modern Stirling engine goes back much further than that — to 1937, when the N. V. Philips' Laboratories at Eindhoven, Netherlands, was searching for a portable, silent engine having no radio interference, for driving small electric generators. The power was needed to operate Philips radio equipment in remote regions having no electrical supply. Aside from steam plants, which were not very portable, the search narrowed down to the air engine, and the Philips Research Laboratories have been developing it ever since, in later years in coöperation with General Motors Corp.

The thermal cycle on which the engine operates, the details of its construction, and the history of its development are given in much detail in a paper entitled G.M.R. Stirling Thermal Engine, Part of the Stirling Engine Story — 1960 Chapter, prepared by Flynn, Percival, and Heffner of the General Motors Research Laboratory for presentation at the SAE Annual Meeting in Detroit, Mich, January 11–15, 1960.

The paper begins with a discussion of the heat cycle on which the engine operates and compares it with the other cycles such as the Otto, Brayton, Carnot, & Ericsson.

The engines built and tested to date are of a single cylinder vertical design consisting of five major components: the engine heater and a means of keeping it hot; the regenerator; the engine cooler and the means of keeping it cool; a displacer piston

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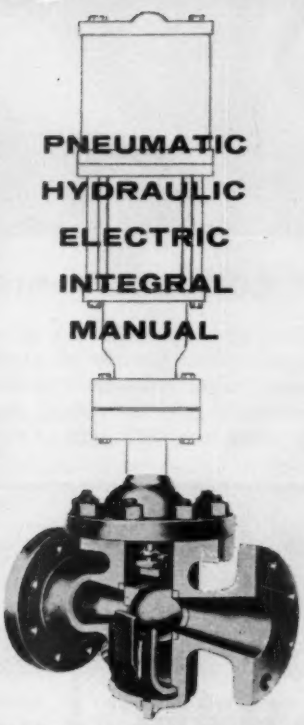

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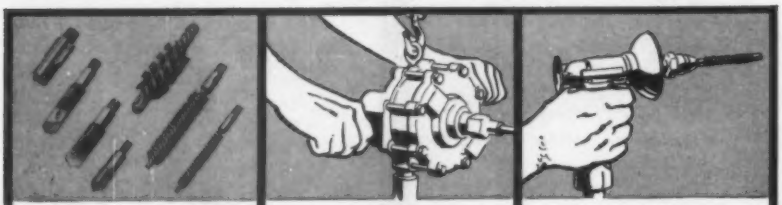

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Brushes for light deposits. Four types of drills clean light, hard-heavy, hard-light, and gummy deposits.

SUSPENSION TYPE
Air, steam or electric heavy-duty motor, for removing hard, heavy deposits. Ball bearings absorb thrust in either direction.

ELLIOTT JIFFY GUN
For extra-fast cleaning of light deposits in tubes ½ in. to 1¼ in. Air or water pressure shoots nylon brushes or rubber plugs through tubes.

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to control the movement of the working fluid through the heater, regenerator, and cooler; and the power piston to compress and expand the gas. This gas may be air or other gases such as hydrogen.

At the top of the engine is a combustion chamber into which fuel and air are injected for burning. The combustion gases pass through a heater, which heats the air in a closed circuit leading into the engine cylinder to drive the power piston. The combustion gases pass out through a regenerator which heats the incoming working air, and the gases exhaust to atmosphere.

The displacer piston controls the movement of air through the heater, and the expansion of the air on the power piston drives the latter. The air in the cylinder does not come in contact with the products of combustion. The vertical motion of the displacer piston and the power piston are transmitted through piston rods to a device called the Rhombic drive at the bottom of the engine — from which the power is delivered.

Small Stirling engines of 8.6 hp at 3600 rpm have a thermal efficiency of 26.4 per cent as compared with 26.1 per cent for a 4-cylinder, 4-stroke Otto cycle engine and 12.2 per cent for a 6-cylinder, 2-stroke auto engine.

In larger engines, a Stirling 40-hp engine at 2500 rpm has a thermal efficiency of 33.3 per cent as compared with 34.0 per cent for a 6-cylinder, 2-stroke diesel, and 28.7 per cent for an automotive V-8 gasoline engine.

The two latter engines are of 210 and 242 hp, respectively, but the report says that if the latter two engines were scaled down to the same total output as the Stirling engine, they would suffer a loss of efficiency.

While the single-cylinder engine suffers some weight disadvantage, the principal and greatest asset of the Stirling engine is its comparatively silent operation and lack of pressure variations that cause noise and vibration.

According to the report, for large engine installations, the weight and efficiency will be at least as good as those of high-economy diesel engines; and the Stirling engine could be used for quiet operation if visible, odorless exhaust or use of special fuels or heat sources warranted additional costs.

In small engine installations of 10 hp or less, the Stirling engine could be used where its significant efficiency and noise advantages compensate for extra weight and cost. The special fuel capability and the clear exhaust would serve as advantages here, also.

New Hydro for Colorado River

EIGHT hydro turbines have been purchased for the new Glen Canyon Project on the Colorado River. These total 1,244,000 hp, and will produce 900,000 kw of power.

Department of the Interior's Bureau of Reclamation awarded the contract to Baldwin-Lima-Hamilton Corporation at a total cost of $6,392,000. Some 42.7 per cent of the total represents parts to be furnished from Belgium.

Bids for the turbine manufacturing contract were opened in Denver on November 24. Award of the contract, however, was held up after English Electric Co, of London, England, the apparent low bidder before evaluation, protested to the Bureau and to the Comptroller General against consideration of B-L-H's bid.

The English firm's offer of $6,214,552 was low among the seven bids received, but when the bid was evaluated to include services of an erecting engineer and the application of the 6 per cent foreign differential, required by the Buy American Act, it was determined by the Bureau's contracting officer to be second low.

The English firm's bid was for equipment all to be produced in England. The American firm, on the other hand, represented that it proposed to furnish supplies of foreign origin equal only to an estimated 42.7 per cent of its total bid price, and that it was therefore entitled to consideration as a domestic firm under Buy American Act procedures.

The Bureau's interpretation of the Baldwin-Lima-Hamilton offer as a domestic bid was sustained by the Comptroller General in an advance decision on April 7, made at the request of the Department of the Interior.

Details of the Dam

The 700-ft-high concrete arch Glen Canyon Dam is the key storage and power-generating feature of the five-state Colorado River Storage Project. On completion, it will be America's second highest concrete dam, dwarfed only by 726-ft Hoover Dam, downstream on the Colorado River. Its volume of 4,770,000 cubic yards of concrete will be exceeded in this country only by Washington's Grand Coulee Dam and California's Shasta Dam.

The power plant will cost approximately $119.5 million of the total $364 million estimated construction cost of the Glen Canyon Dam and power plant. The dam is expected to be completed in mid-1965.

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Available in Spools or in Die-Formed Rings. Rings available with either square cross section or with special bevels for concave-convex nest sets.

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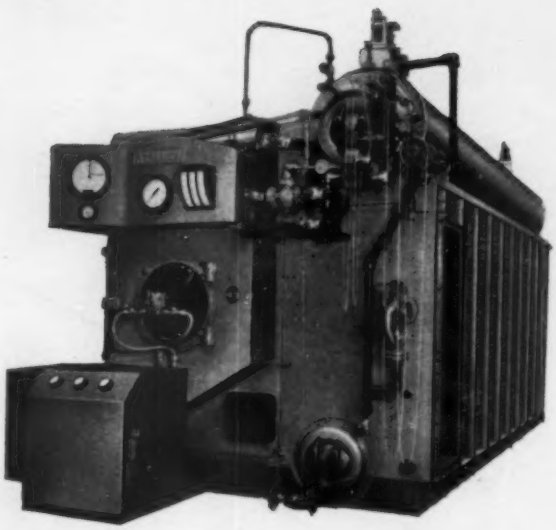
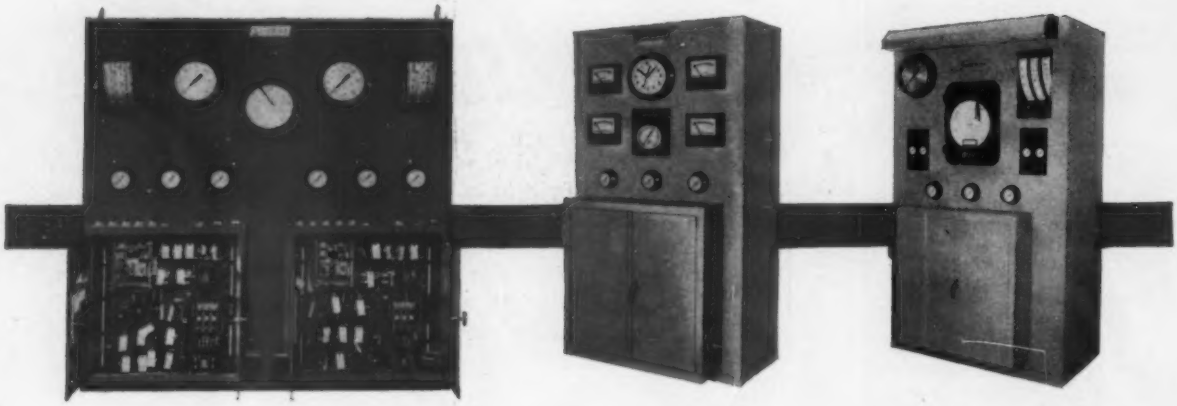
Electrically operated positioning controls for steam or rotary burners are supplied either in console arrangement or free standing panel. Metering controls, either electrically or pneumatically operated, are supplied with steam atomizing burners of all capacities in free standing panels which may be individual for each boiler or combined for two or more boilers.

Safety combustion controls are an integral part of every control panel. Complete factory wiring terminates in a boiler junction box with terminal strip matching identical strip in control panel.

For complete data on Type D Boilers write for catalog D-12



"Type D" Superior Packaged Boiler with integral console for single burners and electric positioning controls.



Duplex panel for two boilers with recording, indicating instruments and individually wired cabinets for combustion safeguard controls.

Control panel with indicating instruments for either rotary cup or steam atomizing burners with positioning controls.

Control and instrument panel with pneumatically operated metering controls for steam atomizing burner installations of all capacities.

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Motive Power

201 Large Generating Units — Design and construction features of large steam turbine generating units are illustrated and described in 40-pp Bulletin 03B9448, Allis-Chalmers Mfg. Co. Subjects covered range from compact component design to controls and instrumentation. Illustrated with photos, drawings and section diagrams. Booklet includes tables of ratings.

202 Solid Wheel Turbines — Advantages of The Terry Steam Turbine Co.'s solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos.

203 Gas Turbines for Peaking — Peaking combustion gas turbines with capacities from 7,000 to 28,000 kw are described in 12-pp Bulletin GED-3761, General Electric Co. Outlines savings possible through lower installed cost, minimum space and personnel requirements, less transmission equipment investment, lower line losses, and lower standby.

204 Gas Turbine Power — Eight-pp Bulletin GEA-7083 of General Electric Co. introduces a line of 75 to 20,000-hp ultra-lightweight, compact gas turbines for a wide variety of applications, including fluid and gas pumping, electric power generation. Covers design features, performance and operating characteristics, current and potential applications.

205 Steam Turbines — Single stage turbines for mechanical drives are featured by Murray Iron Works Co. in 6-pp Bulletin T-126. Schematic drawings showing component features and details of operation and design included.

206 Gas Turbines — The power concept of The Cooper-Bessemer Corp.'s gas turbine based on the J-57 jet engine is discussed in 8-pp Bulletin 95. Describes operating characteristics, thermal efficiencies, maintenance costs, and potential applications, and includes schematic drawings, performance curves and engineering data.

207 Gas Engine — Design features and operating advantages of a V-type turbocharged gas engine designed by Clark Bros. Co. as a compact, high horsepower driver for centrifugal pipeline compressors, generators and liquid pumps are detailed in 26-pp Bulletin 176. Cutaway view shows component features.

208 Standby Generator Sets — Described by General Motors Corp. in this 8-pp bulletin is a line of diesel powered standby generator sets for emergency power. Gives complete specifications on single and multiple-engine standby generator sets.

209 Gas Turbine Engines — Featured in this 24-pp bulletin of Solar Aircraft Co. are engine data, performance curves and applications for gas turbine engines. Explains operation of gas turbines and includes application photos.

210 Natural Gas Engines — Applications of natural gas engines in gas compressor, pipeline, air conditioning, sewage disposal, gas separation, electric, standby and other installations are detailed by Caterpillar Tractor Co. in 8-pp Booklet 20173. Includes basic specifications for natural gas engines, fuel consumption curves.

211 For Standby Power — Selection and installation of standby electric plants and controls is fully detailed in this 8-pp bulletin by D. W. Onan & Sons, Inc. Practical suggestions are offered on planning and designing the installation, items to evaluate to meet particular requirements are listed, and advantages of gasoline and diesel-powered generator sets described.

Lubrication

212 On Centralized Lubrication — Information on a centralized system of lubrication is presented by Farval Div., Easton Mfg. Co. in 24-pp Bulletin 26-T. Advantages and principles of operation are discussed, also system components. Typical applications illustrated.

213 Oilers and Containers — Detailed information on oilers, safety cans, and oil and gasoline containers is presented in 30-pp Condensed Catalog 60-C of Eagle Mfg. Co. Size and capacity along with descriptive details and photos of oilers included.

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214 Turbine Lubrication — Basic lubrication requirements for a wide range of turbines and gears are detailed by Murray Iron Works in Bulletin T-125-A. Sections cover care of the oiling system, turbine lubricants, lubricating oil recommendations, reductions gears and geared units. Oil circuit diagrams included.

215 Organized Lubrication — Benefits of organized lubrication are extolled by Texaco, Inc. in this 24-pp bulletin. Cost control opportunities are detailed, and task of assigning responsibilities in an organized lubrication system are discussed. Method of determining savings and setting up records to measure results covered.

216 Lubricant Data — Characteristics, advantages of specialized fluid and grease type lubricants are described in 32-pp Data Book 59-2, by Lubriplate Div., Fiske Bros. Refining Co. Includes sections on control of friction, use of grease type lubricants, proper applications, and recommendations for various operating conditions.

Metals

217 Steel Analysis — In this 20-pp pocket-size booklet, Jones & Laughlin Corp. lists compositions of 40 stainless steels, 184 alloy steels and 105 carbon steels most often used in industry. It also contains federal specifications with corresponding SAE, AISI and AMS numbers.

218 Rugged Castings — Properties and applications of heat and corrosion resistant castings are given in this 64-pp booklet of The International Nickel Co., Inc. Designed to aid in stainless steel and high-alloy casting selection, it offers comprehensive data on all types of stainless steel and high-alloy heat and corrosion-resistant castings and their applications.

When ordering catalogs don't forget that the Reader Service Cards can also be used to request any literature offered in the ads

219 Ferrous Metallurgy — "Basic Guide to Ferrous Metallurgy" is a four-color chart prepared by Tempil Corp. showing principal characteristics of steels (with carbon content ranging to 0.9 per cent) across the temperature range to 1900 F. Important working zones including preheating for welding, stress relieving, normalizing, annealing, carburizing and forging are shown.

220 Using Specialty Steels? — Offered by The Carpenter Steel Co., this 40-pp guide to selection of specialty steels contains information on tool and die steels; stainless steels; high temperature alloys; electronic; magnetic and electrical alloys; special purpose alloy steels; tubing and pipe, fine wire specialties. Includes tool steel selector chart providing a system of matching tool steels.

Ventilating, Refrigeration and Air Conditioning

221 Industrial Fans — Fundamental data relating to capacities and construction of industrial fans incorporating a universal discharge are presented by Lehigh Fan & Blower Div. of Fuller Co. in 28-pp Bulletin L-5. Included are rating tables giving volumes of air delivered, rpm, horsepower at various static pressures, and outlet velocity and velocity pressures, as well as tables of correction ratios for deviations from the standard atmospheric conditions.

222 Centrifugal Fans — Catalog 1120-1 of Westinghouse Electric Corp. contains 76 pp of detailed information on all-purpose centrifugal fans with flat, backwardly inclined blading, suited for supply and exhaust, general building ventilation, industrial air conditioning and processes. Key components and features are illustrated, and tabular performance data included.

223 Air Engineering — Bulletin E-57 is a 24-pp air engineering data file, offered by Aerovent Fan Co., Inc. Covers engineering and test facilities for propeller fans, specifications, construction, maintenance, and installation. Tables for estimating air-handling requirements, entrance and elbow losses provided.

224 For Controlled Ventilation — This 20-pp catalog of The Loren Cook Co. is designed as a guide in determining exact type ventilation equipment for specific needs. Guide matches design features with ventilation requirements and special conditions, controlling efficiency, and economy and lengthening life of unit. Includes performance and dimension charts.

225 Plastic Ventilating Equipment — Illustrated and described in 18-pp Bulletin B-500 are plastic ventilation products of Heil Process Equipment Corp. including ventilating ducts. fittings, exhaust hoods, stacks, covers, fans, and fume scrubbers. Physical and chemical properties of glass-reinforced plastics given.

226 Conditioner Units — Design features of Climate Makers, based on the building block principle, are detailed by Airfan Engineering Co. in 60-pp Catalog AHV-59. Engineering information provided includes fan capacities, direct expansion cooling capacities, and coil data, chilled water cooling caapcities, chilled water coil data, mean effective temperature, psychometric data, steam and hot water heating capacities.

227 Cold Room Conditioning — In Bulletin 95, Niagara Blower Co. describes the No-Frost method of producing temperatures down to −90 F for freezing, testing, cold storage etc., giving advantages. Operation with two-stage and three-stage cooler discussed.

228 Coil Selection Guide — Information on Young Radiator Co.'s water and direct expansion refrigerant coils is given in 28-pp Catalog 5559. Provides selection data on water heating and cooling coils; physical and performance charts; mean effective temperature difference charts. Explains determination of final dry bulb temperature and direct expansion coil surface temperatures. Also includes capacity tables, psychrometric chart, total heat table, dimensions, piping diagrams.

229 Air-Cooled Condensers — Four types of air-cooled condenser units are discussed by Halstead & Mitchell in 12-pp Bulletin AC-102 — those using propeller fans for horizontal air flow, propeller fans for vertical air flow, centrifugal fans for use with ductwork, and centrifugal fans. Coil and fan data are given as are capacities in Btu per hour at evaporator, also detailed specifications.

230 Refrigeration Condensers — Engineering data on a complete range of sizes and types of refrigeration condensers are featured by Henry Vogt Machine Co. in 38-pp Bulletin RC-2. Ratings in tons refrigeration are tabulated for large and small ammonia condensers, vertical ammonia condensers, ammonia condenser-towers, freon condensers and freon condenser-towers.

231 Refrigerated Purging Guide — In 12-pp Bulletin 700, Armstrong Machine Works gives helpful data on automatic removal of air from refrigeration systems. Tells why purging is necessary, how non-condensible gases affect efficiency, methods of purging, where to make purge connections and how to use the refrigerated purger.

232 Zone Control Cabinets — Illustrated and described in 20-pp Bulletin AC-220 are Buffalo Forge Co.'s sectionalized easy-to-assemble units with separate fan section, coil section, zone dampers and optional accessories. Includes physical data, dimensions, fan performance tables, coil ratings, and selection data.

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Mechanical Power Transmission

233 Improved Drives — Catalog GB-201-A, Browning Mfg. Co. contains 58-pp of selection data on Gearbelt drives which combine flexibility of belt drives with advantages of chain and gear drives. In addition to specifications, it contains design and installation suggestions, engineering data.

234 Variable Speed Drives — Designated M-592, this 96-pp catalog explains through copy, photos and drawings the wide assortment of styles, modifications and accessories available in mechanical variable-speed Motodrives offered by Reeves Pulley Div., Reliance Electric and Engineering Co. Includes construction features, speed and rating tables, and pricing information.

235 Fluid Drives — Well illustrated 20-pp Bulletin A-719, on American-Standard's Class 4 adjustable speed Gyrol fluid drives, discusses principles of operation and shows typical applications. Horsepower and inertia starting capacity curves are provided. Components of the unit are illustrated. Selection guide charts are presented for both variable torque and constant torque applications.

236 Magnetic Drives — Performance data on magnetic drives designed to provide overload protection even under extended full stall are presented in 12-pp Bulletin TP-1-60 by Tormag Products Div., Gleason Reel Corp.

237 Speed Reducers — Catalog 590 is a 65-pp supplement to Ohio Gear Co.'s 186-pp general catalog on stock gears and speed reducers. It provides complete engineering data, dimensions and application selection charts on the Hi-Line series fin and fan cooled reducers. Catalog is pocket size, designed for convenient location of engineering data.

238 Motorized Reducers — Bulletin 3100, 28-pp provides up-to-date information on The Falk Corp.'s all-steel Motoreducers in types to meet all requirements. Includes data on new Size E offering increased capacity but requiring little more space. Text and illustrations show how basic design permits maximum use of standardized parts, affords wide choice as to output shaft position, connection and speed, type of motor, mounting etc.

239 Power Transmission Equipment — Design and construction data on power transmission equipment, including variable speed pulleys, V-belts, sheaves, motor bases, counter-shafts, and transmission drives are presented by Lovejoy Flexible Coupling Co. in 32-pp Catalog P-58. Includes ratings and dimensions, also mounting diagrams.

240 Heavy Duty Transmissions — Standard transmissions customized to each application is the theme of this 8-pp bulletin of Cotta Transmission Co. describing heavy-duty transmissions with input torque capacities of 150 to 2500 ft-lb. Examples of standard single speed, multiple speed, and right-angle drives are illustrated with complete lists of input torque capacities, speeds, gear ratios.

241 Compact V-Belt Drives — Described by T. B. Wood's Sons Co. in 36-pp Bulletin 9102 are V-belt drives designed to utilize advantages of synthetic fibers and rubbers and high strength metals to achieve compactness, strength and economy. Includes drive selection tables, horsepower tables, nomograms for comparison of drive costs, sheave and belt specifications, bushing and keyseat specifications.

242 Multiple V-Belt Drives — This comprehensive manual of R & J Dick Co., Inc., contains 68 pp of engineering data for design of multiple V-belt drives with company's method of "tempered" construction designed to increase belt horsepower rating, minimize stretch, increase resistance to abrasion and shock, and add flexibility. Contains photos, drawings, charts, tables and other data covering selection and design factors.

243 Variable Speed Belts — Catalog VSB-1 is a 32-pp belt selection guide prepared by Maurey Mfg. Corp. for variable speed belt users. In addition to ratings, sizes and engineering data, it provides such reference information as alphabetical listing of applications, numerical listing of parts numbers, numerical listing of applications, and variable speed cross reference tables.

244 Power Transmission Belting — Advantages and applications of varied types of belting for V-drives, positive drives and variable-speed drives are detailed in 24-pp Catalog B-60, Maurey Mfg. Corp. Explains difference in design and construction between V-belts with synthetic cord load carrying sections and steel cable load carrying sections, discusses the respective places of positive drive belts and variable speed belts in modern power transmission.

245 Eddy Current Coupling — Presented in 12-pp Bulletin GEA-6885 is extensive information on General Electric Co.'s Kinatrol line of eddy current coupling adjustable speed drives for 5 to 100 hp. Describes operating principle and contains data on torque capabilities, regulation and operation of entire package drive, cross-sections, dimension charts, ratings.

246 Flexible Couplings — Comprehensive selection data on flexible couplings is presented by Thomas Flexible Coupling Co. in 58-pp Engineering Catalog 60. Misalignment is described and basic coupling arrangements and load classifications are included, along with photos of couplings and installations, diagrams and tables.

247 Stock Chains, Sprockets — Listed in 44-pp Book 2757 are stock sizes of Link-Belt Co.'s chains and sprockets. Key indexed for easy reference, book presents 200 types and sizes including standard and double pitch power transmission chains, conveyor chains and attachments and sprockets. Lists standard roller chains — single, double, triple and quadruple strand — together with heavy series roller chains, corrosion-resistant stainless steel and bronze types.

248 Chain and Sprockets — Roller chain and sprockets designed to meet nearly all roller chain requirements are described by Dodge Mfg. Corp. in 56-pp Bulletin A691. Covers single strand, double strand, single strand heavy, double pitch drive, double pitch conveyor, double pitch conveyor with large rollers, and standard attachments. Bulletin provides photos and diagrams showing construction details, selection data, installation information, calculation of center distances, horsepower ratings, and lubrication data.

249 For Mounting Bearings — Selected engineering drawings for mounting Reali-Slim bearings are presented by The Kaydon Engineering Corp. in 28-pp Bulletin S-112R. Low cost, light weight, space saving features are emphasized, specifications and prices for off-the-shelf ball radial type bearings included, as well as engineering drawings of installations.

Insulation, Refractories

250 Pipe-Fitting Insulation — Design features and advantages of an improved molded Fiberglas pipe fitting insulation, are detailed by Fibrous Glass Products, Inc. in Bulletin TD-105. Specifications included.

251 Underground Piping Insulation — Advantages and characteristics of a granular insulation for underground steam lines, are detailed by Insul-Fil Co., Inc. in eight data sheets. Application details are illustrated and described and complete specifications included, as well as engineering drawings and graphs.

Postage-free Reader Service Cards are on pages 119-120

Pumps and Compressors

252 Insulation Specifications — Johns-Manville's 50-pp manual of specifications, IN-128A, is designed for power, chemical and petroleum industries. It is divided into five sections — insulations for temperatures above 100 F; those for temperatures below 100 F; tank insulation; sphere and spheroid insulation; regenerator, catalytic reactor and oil heater lining and insulation. Tables include recommended thicknesses for both steam generating plants and process equipment based on average economic conditions.

253 Insulation Specifications — In this set of six specifications, Pittsburgh Corning Corp. covers applications of Foamglas insulation for industrial equipment and piping. Each booklet contains tables of suggested thicknesses of insulation to be applied, drawings of insulation procedure, supports and recommended finishes. Booklets are devoted to low-, medium-, high-, and dual-temperature equipment, to underground piping, and spheres.

254 Thermal Insulation — Described in 54-pp Catalog IN-244A are Johns-Manville thermal insulations for all types of commercial and industrial requirements from —400 to 3000 F. Contains six sections, each devoted to a specialized group of insulations, including industrial and high temperature; plumbing, heating and air conditioning; refrigeration; insulating firebrick and refractories; finishes and weatherproofing materials; also asbestos papers, millboard, felts, blankets.

Letters from readers are always welcomed by the editors—but the easiest way to get these catalogs is to use the Reader Service Cards provided

255 Insulating Materials — Properties and specifications of over 30 insulations for service from sub-zero to 1900 F are presented in this 24-pp 1960 catalog of Baldwin-Ehret-Hill, Inc. Spun mineral wool, calcium silicate, and 85 per cent magnesia products in block, blanket, felt, fill cement, and pipe insulation are described. Thermal conductivities and tables of recommended thicknesses are given. A selection chart indicates temperature ranges of all included materials.

256 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-pp folder of Refractory and Insulation Corp. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases.

257 Refractory Mortar — This is a 24-pp manual covering the use of Lumnite calcium-aluminate cement as a mortar mix for gun-applied linings in power plant refinery and metalworking equipment offered by Universal Atlas Cement Div., United States Steel Corp. includes data on mortar preparation, placing procedures, curing; also information on use of Lumnite cement as a masonry mortar for brick.

258 Vertical Turbine Pump — Featured by Worthington Corp. in 16-pp Bulletin 2400-B1 are ultra high flow vertical turbine pumps. Design improvements, which result in broader coverage and higher efficiencies over wider operating ranges, are illustrated and described.

259 Submersible Sump Pump — Eight-pp Bulletin 5300, The Deming Co., describes features and operation of a submersible sump pump which can be lowered into a pit for temporary service or permanently installed for continuous service. Performance and dimension tables included.

260 Metering Pumps — Introduced by Wallace & Tiernan, Inc. in this 12-pp catalog is the Series 200 metering pump, an electrically driven pump of positive displacement, reciprocating, plunger type, capacities from 0.65 to 2025 gph. Design and operating features, possible arrangements and standard materials of construction are covered.

261 General Purpose Pumps — In 12-pp Bulletin B-2100, Peerless Pumps Div. of Food Machinery and Chemical Corp. describes general purpose, horizontal, centrifugal split-case pumps for hot and cold water handling, circulation and boosting. General characteristics, dimensional data, and selection charts are included, as well as drawings showing construction.

262 Free-Piston Pumps — Features and advantages of an air-operated free-piston pump designed to pump anything that flows are detailed by The Crossley Machine Co. in this product bulletin. Sequence diagrams showing operation included.

263 Proportioning Pumps — Details on proportioning pumps and package chemical feeding units for controlled capacity are presented in a product bulletin released by The Bird Archer Co. An application chart and detailed specifications are included.

264 Pumps and Controls — Bulletin 220 contains 72 pp of data on design details and operating characteristics of hydraulic pumps, fluid motors and valves offered by Dennison Engineering Div., American Brake Shoe Co. Sections are devoted to types of hydraulic pumps, pumping units, fluid motors, and control valves, covering design and operating characteristics of components involved, with tables of performance data.

265 For Abusive Pumping Jobs — Catalog 5206, Nagle Pumps, covers centrifugal pumps adapted to handling ashes, abrasive mixtures, slurries, hot and corrosive liquids. It describes several basic types: a horizontal shaft, single-stage side suction pump; a horizontal shaft, single-stage, rear-entrance automatic priming pump; vertical shaft pumps with standard, overhead and quill bearings for wet pit applications.

266 Compressed Air Fundamentals — Sixteen-pp Form 1548, Ingersoll-Rand Co., is intended to aid in selection of a small "packaged" air compressor. Discusses compressed air, how it is compressed, single- and two-stage compressors, piston displacement, control used etc. Includes information on compressor oils, pipe sizes, wire sizes, terminology. Also provided is data on cubic feet of air required to operate a variety of pneumatic equipment.

267 110 Psi Air Compressors — Bulletin 185, 12-pp Clark Bros. Co., presents Balanced/Opposed air compressors for standard 110 psi industrial applications. Describes details of the compact heavy-duty design; cylinders; rugged crankcase and compressor cylinder construction; overhung rotor, three- and five-step unloader controls etc. Specifications cover all 23 models (including units for soot blowing).

268 Station Compressor — Bulletin A-72, 24-pp, describes Joy Mfg. Co.'s WN-114 stationary air compressor offering simplified installation through package design. Includes specifications on three basic models of the semi-radially constructed units ranging from 1385 to 1948 cfm at 125 psi. Design components are illustrated.

269 On Eliminating Explosions — In 12-pp Bulletin 173, Clark Bros Co., presents recent findings on mechanism of explosions in pipelines and compressor starting air lines. Discusses research on nature of explosions and shock waves in piping, and these observations are applied to compressor air starting systems. Concludes with discussion of preventive measures for eliminating such explosions.

270 Water-Cooled Compressors — Bulletin 351, 6 pp, presents 29 advanced features of Class 3-ATC Oilfre compressors of Pennsylvania Pump and Compressor Co. Sizes, capacities and ratings are tabulated. Stresses low maintenance and suitability of these compressors for food processing and other applications in which oil-free compressed air or gas is required.

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Steam Boilers, Heat Exchangers

271 Packaged Steam Generator — The performance story of a prototype stoker-fired packaged steam generator in one typical installation is told by Foster-Wheeler Corp. in 8 pp Bulletin PG-59-4. An evaluation of performance is presented.

272 Automatic Boiler — Application of the Coal-Pak automatic package boiler to low-pressure steam heating, hot water heating, and high-pressure process steam is covered by Bituminous Coal Institute in 36-pp Guide Specifications GS-3. Sample specifications included, coal and ash handling, wiring, and boiler room layouts.

273 Automatic Boilers — Twelve-pp Catalog 120, Lookout Boiler & Mfg. Co., describes an automatic, horizontal Scotch Marine type boiler. Design and construction features are explained and specifications included.

274 Three-Pass Unit — Featured by The Titusville Iron Works Div., Struthers Wells Corp. in Bulletin B-3240 is a three-pass power and heating unit with all wet back construction. In addition to mechanical and thermal features, results of operational tests given.

275 Packaged Boiler — Features and advantages of a packaged fire-tube boiler, Type CF, for capacities from 400 to 600 bhp are detailed by Superior Combustion Industries, Inc. in this product bulletin. Cutaway view showing component features included, also dimensions.

276 Water Tube Boilers — Catalog SB-57R contains 20 pp of detailed information on Erie City Iron Works' two-drum water tube factory assembled boilers. Sectional views, dimensional drawings and mechanical data on the oil, gas or coal-fired units included.

277 Steam Generator — Bulletin F-14 contains 32 pp of detailed information on E. Keeler Co.'s water tube type steam generator. Photos and diagrams illustrating design and construction features are included.

278 Hot Water Boilers — Twenty-pp Brochure HCC-2 of Combustion Engineering Co., Inc. describes and illustrates design, construction, advantages and economics of the C-E La Mont controlled circulation hot water boiler. The unit is for supplying high pressure, high temperature water for heating and process uses.

279 Packaged Boilers — A complete discussion of firetube boilers — from construction features to final test and start-up service — is presented in 12-pp Bulletin Form AD-178, Cleaver-Brooks Co. Full-color cutaway drawings illustrate features and design of packaged boilers through 600 hp for heating and processing, steam or hot water.

280 Integral-Furnace Unit — Bulletin G-94, The Babcock & Wilcox Co. describes Type PFI integral-furnace boiler, a pressurized-furnace oil- and gas-fired steam generator for power, process or heating loads requiring steam capacities to 400,000 lb-hr at pressures to 1150 psi and temperatures to 900 F. Includes information on membrane wall.

281 Package Boilers — This 12-pp booklet on package steam generators describes the formulas behind all package steam generators. Published by Crane Co.'s Cyclotherm Div., it tells how installation of a package steam generator can raise steam capacity in an existing boiler room.

282 Automatic Boilers — Powermaster Model 3 packaged automatic boilers are described by Orr & Sembower, Inc., in 12-pp Bulletin 1260. Boiler types, including gas, oil and combination gas-oil models, a specially-designed hot water boiler, and steam atomizing principle for use with No. 6 oil are included. Ratings and dimensions of all sizes given.

283 Heat Exchangers — Shell and tube heat exchangers, including copper base alloy, steel and stainless steel fixed tube bundle heat exchangers, are illustrated and described by The Young Radiator Co. in 16-pp Catalog 1258A. Includes tables of pressure ratings and material specifications for steam service heat exchangers, selection data, oil viscosity graph, tables of weights and dimensions.

Catalogs reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

284 Heat Exchangers — Engineering Manual PB-EM 102-A, The Carbone Co., contains 22 pp of illustrations, cutaways, diagrams and design data on Polybloc impervious graphite heat exchangers, corrosion-resistant, high thermal conductivity units. Provides charts, graphs, typical calculations, examples and specifications. Covers principles of operation.

285 Industrial Heat Exchanger — This selection data form of The Air Preheater Corp. covers industrial heat exchangers, including a package regenerative air preheater for industrial process or boilers in a range from 25,000 to 250,000 lb per hr; recuperative type heat exchangers for high temperatures, high pressure applications where leakage cannot be tolerated; and a compact rotary regenerator.

286 Heat Transfer Equipment — Design and construction features of heat transfer equipment are detailed in 20-pp Bulletin HE-8 of Henry Vogt Machine Co. Covers the positive seal baffle, film type heat exchangers, waste heat boilers, high pressure and high temperature heat exchangers, heat exchangers of special alloy metals.

Engineering Office Equipment

287 Keep it Clean — How to clean and protect engineering drawings is told by Keuffel & Esser Co. in this 6-pp folder. Describes cleaning aides and protective spray, giving ordering information, prices.

288 Reproduction Materials — Drawing and document reproduction material of Eastman Kodak Co. are featured in this 20-pp bulletin. A reproduction materials selection chart lists a variety of reproduction jobs, type of equipment to be used and materials needed.

289 Facts About Microfilm — "Let's Take a Positive Look at Microfilm" is an article reprint offered by Minnesota Mining and Mfg. Co. discussing merits of using microfilm as an active tool of business and industry. Typical applications shown.

290 Typing Engineering Symbols —A method of using an electric typewriter for quick, convenient typing of special symbols and equations needed in the field of engineering is the subject of this 8-pp bulletin of Sperry Rand Corp.'s Remington Rand Div. Describes variety of symbols which can be snapped on.

To use Post Cards, circle item numbers of catalogs wanted

Electrical Equipment

291 Sychronous Motors — Advantages of The Ideal Electric & Mfg. Co.'s high speed synchronous motors are detailed in 12-pp Bulletin 401. Cutaway view illustrates component parts and details of maintenance and operation. Applications and specifications data included.

292 FHP Motors — Twelve-pp Bulletin GEA-6424A discusses features and advantages of General Electric Co.'s fractional horsepower, Form G, general purpose motors, including capacitor-start, split-phase, permanent-split capacitor, shaded-pole and polyphase motors. Sixteen different kinds of fhp motors are shown.

293 Submersible Pump Motors — Eight-pp Bulletin F-2000, U. S. Electrical Motors Inc. contains full-length cutaway drawings showing construction details of features of submersible motors for 6-, 10- and 14-in. well diameters and explains their water-filled operating principle. Also presents exploded and assembled views of the motors' thrust bearing.

294 Improved Cables — Varnished Dacron glass insulated cables are described in 12-pp Bulletin WC-8319, illustrated in color. In it, General Electric Co. stresses advantages afforded by use of varnished Dacron glass tape insulation — longer life, smaller diameter, greater current carrying capacities etc. Physical and electrical properties of the insulation are presented.

295 Mineral Insulated Cable — Properties and applications of mineral insulated cable, including hazardous area applications, are detailed by General Cable Corp. in this 16-pp bulletin. Includes specifications, installation data, lists construction and performance characteristics.

296 Wire and Cable Data — These composite, color-coded data sheets contain information formerly found only in many catalogs on wires, cables and power cords. Prepared by Continental Copper & Steel Industries, Inc. data sheets give prices, stranding, strand diameters, temperature ratings, weights, overall diameters.

297 Portable Cords, Cables — Specifications and characteristics of various portable cords and cables are presented in this 52-pp booklet of Kaiser Aluminum & Chemical Sales, Inc. Gives pertinent data on insulation and jacket compounds, and includes tables giving properties of 600-v portable cables, from single to four conductor, also single- to four-conductor 601-5000v portable cables, and others. A section is devoted to splicing and patching.

298 Why Plastic Conduit — Advantages of using plastic conduit in a variety of electrical applications are detailed in this 6-pp bulletin of Southwestern Plastic Pipe Co. Mechanical, physical and electrical properties and other data are tabulated and installation discussed.

299 General Purpose Controls — Catalog 1260D, 72 pp, contains information on general purpose control devices available from General Electric Co. Charts are listed for motors from ¼ through 200 hp, affording quick selection of heaters and push button stations. Product descriptions are provided for both manual and magnetic motor starters, relays, solenoids, limit switches, push buttons, static control and pilot devices. Pricing tables are included, also information on features, wiring, dimensions.

300 Electric Motor Controls — Contained in 72-pp Catalog 5900 of Furnas Electric Co. are selector charts for magnetic and manual starters, giving horsepower, motor speed, heater size, heater ampere ratings, enclosure choices, along with style numbers and list prices. Covers manual starters, magnetic controls, drum controllers, pressure switches, various pilot devices.

301 Reduced Voltage Starter — Eight-pp Bulletin GEA-6860, General Electric Co. defines reduced voltage starters, tells when and where to use them and how to select them. Contains starter selection table and comparison table. Illustrations show the manual autotransformer, magnetic autotransformer, primary resistor, and part winding starters, and schematic connection diagrams are included for each.

302 Voltage Regulators — Distribution voltage regulator features designed to provide more economical and better voltage regulation are described by Allis-Chalmers Mfg. Co. in 16-pp Bulletin 21B7977E. Describes unit construction, electrical re-settable position indicator, quick-break mechanism, optimum system size, oil sight gage, locked control knobs, external by-pass arrester, operation counter, bearingless voltage regulating relay.

303 Circuit Breaker Accessories — Twelve-pp Bulletin GEA-6757 describes General Electric Co.'s industrial molded case circuit breaker accessories and modifications for a variety of control applications. Includes detailed selection data, outline dimensional drawings.

304 Circuit Breakers — Low voltage stored-energy power circuit breakers are discussed by General Electric Co. in a 20-pp Bulletin GEA-5915E. Includes photographs, diagrams, graphs, charts showing specifications, operating features, dimensions, ratings for low voltage power circuit breakers and applications. Manual and electrical stored-energy closing mechanisms are described in a range of ratings through 600 v, 4000 amp.

305 Interrupting Capacity Chart — This chart, prepared by Westinghouse Electric Corp., aids in selecting and ordering proper circuit breaker for each application. In addition to interrupting ratings, chart tables of available fault currents are included.

306 Electrical Distribution — Comprehensive information on electrical distribution products is presented in this 60-pp catalog of I-T-E Circuit Breaker Co. Divided into three main sections covering molded case circuit breakers, individually-enclosed low-voltage power circuit breakers, and engineered products, it contains selection and application data, selection charts listing types, ratings and accessories.

307 Electrical Distribution, Control — Complete with photos, tables of specifications, pricing information, wiring diagrams, this 155-pp reference catalog of Federal Pacific Electric Co. covers 30 types of products. They include circuit breaker load centers, fusible service equipment, enclosed safety switches, low voltage fuses, molded case circuit breakers, enclosed industrial breakers, wall mounted air breakers, bolted pressure contact switches, lighting and distribution panelboards, distribution switchboards, package power centers, wireways, bus duct, manual starters, others. Book is available to qualified power engineers.

308 L-V Distribution Equipment — General Electric Co.'s 84-pp, 1960 Buy Log covers log-voltage distribution equipment. It serves as a condensed buying catalog for service entrance equipment, light and heavy duty safety switches, tumble and open-knife switches, hinged wireway, circuit breakers, switchboards, motor control centers, sectional distribution centers, panelboards and busway. Among features provided are selector charts, pictorial descriptions, consolidated pricing tables.

309 Overload Fault Currents — Sixteen-pp Section 7 of an aluminum conductor engineering data series offered by Aluminum Co. of America, discusses overload and fault current limitations of bare aluminum conductors. Includes description of fault and overload currents, along with graphs showing maximum allowable time for various high value emergency or short circuit currents.

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310 Protective Equipment Guide — Form SPD is a 24-pp handbook on selection of protective devices for electric circuits, motors, appliances and apparatus. Prepared by Bussmann Mfg. Co. and based on 1959 National Electrical Code, it provides suggestions on how to select right kind of protection equipment, wiring diagrams amd motor tables.

311 Electric Utility Instruments — General Electric Co.'s Bulletin GEZ-2975 contains 12 pp of information on instruments for generating plants, distribution areas, load-dispatching offices, substations, and electrical testing. Contains selection data on units for specific applications.

312 Testing Instruments — Twelve-pp Bulletin 19-60 contains descriptive information on industrial instruments available from James G. Biddle Co. They include electrical resistance testers, dielectric test sets, cable fault locating equipment, turn ratio test sets, and others. Advantages are detailed.

313 Portable Test Units — Presented in this 48-pp booklet of Multi-amp Electronic Corp. is detailed information on portable test units for protective relays. Subjects treated include classification of relay tests; preparation for protective relay testing; reasons for an adequate testing and maintenance program; tips on tester selection. How the test units can aid in relay functioning is discussed.

314 Tungar Bulb Data — Eight-pp Publication ETR-2091, a revised edition of General Electric Co.'s manual on Tungar bulbs, contains typical circuits and operating data. Also provides descriptive and theoretical data on use of Tungar bulbs in rectifier circuits to provide noise-free power supplies with low voltage drop and high efficiency.

315 Printing Demand Meters — General Electric Co.'s Bulletin GEA-6892, 8-pp, describes printing demand meters for precision recording of loads. Discusses application, design, and cost of PD-55F and PD-57F meters. Also includes operating, construction and electrical specifications, and dimension diagrams of units.

316 Electrical Insulation — Twelve-pp Bulletin GET-2929A describes in text, tables and illustrations the characteristics and applications of General Electric Co.'s insulating materials for electrical equipment. Provides technical data and suggested uses of such products as mica mat, built-up mica, coated materials, varnishes, paints, adhesives, compounds, thinners, irradiated materials, others.

317 Insulation Materials — Illustrated 36-pp Catalog 34 presents electrical insulation for repair and maintenance of motors, generators, and electrical or electronic equipment. Prepared by Insulation Manufacturers Corp. covers packaged insulation products: cotton, asbestos, and woven glass tapes; cotton, glass and varnished or saturated tubing and sleeving; Mica plates and laminates; varnished fabrics; insulation papers; high temperature insulation materials for Class H units; baking and impregnating varnishes; pressure sensitive tapes.

318 Surface-Coating Insulation — Properties and uses of Limitrak, surface-coating insulating material for electrical equipment, are detailed by Westinghouse Electric Corp. in 8-pp Booklet MB-1908-A. Covers physical and electrical properties, chemical resistance to various materials, its arc and track resistance.

319 Electrical-Insulating Varnish — This 36-pp catalog of Minnesota Mining & Mfg. Co. covers selection and application of electrical insulating varnishes with complete details on all electrical and mechanical properties as well as operating temperature limitations. Includes charts, graphs and illustrations on temperature conversion, solvents, specific gravity, viscosity.

320 Battery Technology — Bulletin GB-1896 is a 36-pp handbook of technical instructions and engineering data on the care of motive power storage batteries offered by Gould-National Batteries, Inc., it covers all phases of lead acid battery theory, operation and maintenance. Captioned line drawings are included as well as changes, charging and discharging cycles, plate composition.

321 Battery Chargers — Selenium or silicon rectifier battery chargers designed for station-type batteries used by utilities and industrial plants are described in this product bulletin of Syntron Co. Specifications, data and descriptions of standard models ranging from 15- to 200-amp capacity included.

322 Motor-Generator Chargers — Operation and maintenance procedures for automatically controlled vertical motor-generator chargers for lead-acid storage batteries are provided in 8-pp Form 5845, Exide Industrial Div., The Electric Storage Battery Co. Contains instructions on day-by-day operation and long-range preventive maintenance of equipment, installation data and wiring diagrams.

323 Electrical Equipment Guide — Describing heavy duty electrical transmission and distribution equipment for commercial, industrial and other installations, this catalog digest of Continental Electric Equipment Co. contains detailed specifications. Presents interrupter, switches, medium voltage switchboards, unit substations, power centers, low voltage switchgear, panel type switchgear, bus ducts, bus plugs, motor control centers, panelboards, circuit breakers, safety switches, instrument and control boards. An "easy price estimator" is included. Available to qualified power engineers, please state your job title.

324 Channel, Fittings, Hangers — This pocket-size reference type work manual, about 68 pp, contains product illustrations and correlated information for specifying and using structural support materials for electrical installations. A publication of Steel City Electric Co., it is indexed to sections identified with specific areas of applications . . . as for suspending single and multiple runs of conduits: building racks and frames; concrete inserts; beam clamps for fastening to structures; brackets and supports; fluorescent fixture supports. Tables show strength of sectional units, deflections and load bearing capacities.

325 Low-Voltage Switching — Twenty-pp Electrician's Manual RM-610 offered by Remcon Div., Pyramid Instrument Corp., contains an introduction to low-voltage switching. Explains how company's remote-control switching works electrically, how components are mounted, how to plan a layout, and gives installation instructions.

326 Power Supply Handbook — Tabular specification data on regulated d-c supplies, frequency changers (variable frequency power sources) high-voltage power supplies (to 600 kv) and other high-voltage products, miniature transistorized power supplies, inverters and converters, and a-c line-voltage regulators are presented by Sorensen & Co., Inc. in this 32-pp power supply handbook.

Hose and Fittings

327 Improved Pressure Hose — Form NEPR-500, 25-pp, of the Imperial Brass Mfg. Co., presents Hytron hose and couplings, described as a new concept in pressure hose performance attained with all-synthetic Hytron. A section on engineering facts covers its advantages, applications, limitations. Booklet also gives ordering and assembly instructions, tips on installation, chemical resistance tables, temperature and pressure ranges.

328 Industrial Fire Hose — Physical and chemical properties of industrial fire hose jacketed with Dacron are detailed in 12-pp Bulletin D-115 by E. I. du Pont de Nemours & Co. Tables of chemical exposure tests are included.

329 Hose, Fittings, Couplings — Industrial Catalog 204, about 40-pp, contains information on hose, fittings, self sealing couplings and related products of Aeroquip Corp. Provides specifications on products for general industrial applications, power plants, others. A hose selector chart lists applications and fluids for which specific hose types are recommended. Instructions for ordering and assembling hose lines are also given.

330 Hose and Fittings — Comprehensive data on The Weatherhead Co.'s hose and hose assemblies, brass and steel tube fittings, hose and tube working tools, stock cabinets, hose racks and other specialty products are presented in 128-pp Catalog C-300. Profusely illustrated, it contains hose selector chart, assembly data chart, detailed specifications, application and installation instruction. Available to qualified power engineers, please state your title when requesting this.

331 Rubber Hose — Illustrated and described in Mercer Rubber Co.'s 24-pp. Form 1059, is a line of rubber hose for a variety of industrial, processing, and utility applications. Application and construction details are included, along with dimensional data, weight, working pressures in chart form.

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Construction Materials

332 For Roof, Wall Construction — Included in this literature file offered by Elwin G. Smith & Co., Inc. are product bulletins describing roof and wall construction materials. Bulletin 59C, covers corrugated sheets; 59W, insulated walls and metal panels; 595, insulated sandwich curtain walls and roofs; Bulletin 60D, steel and aluminum roof deck; Bulletin 60F, high-strength permanent steel forms for concrete roof and floor slabs; and Bulletin 60R, conveyor hoods and curved corrugated sheets.

333 Iron-Impregnated Floor — Discussed by The Master Builders Co. in 24-pp Bulletin Mp-4d are features sought in design of industrial floor subject to heavy use, such as wear and corrosion resistance, economy, spark resistance, static-dissemination, color, easy maintenance. Photos, diagrams and text cover method of application and typical installations of Iron-Clad concrete floor.

334 Gratings, Treads — Illustrated and described in 24-pp Safety Handbook 60 are safety gratings, stair treads, safety edgings and step bars of Bustin Steel Products Inc. Covers advantages and applications of the six types of safety gratings available for every type of industrial need, illustrates installations.

335 Floor Gratings, Treads — Three basic grating types used in construction are illustrated and described by Borden Metal Products Co. in this 16-pp bulletin. Includes dimensional drawings of these and other gratings; safe-load tables for steel grating, aluminum grating, sidewalk slabs, others.

336 Safety Grating — Features and advantages of The Globe Co.'s steel, aluminum and stainless steel safety grating are illustrated and described in 24-pp Catalog 5911. Describes types of loading and includes load charts.

337 For Masonry Anchoring — Catalog 25 is a 48-pp pocket-size handbook of anchoring and drilling devices produced by The Rawlplug Co., Inc. for fastening anything to masonry. Includes tables showing proper anchors for each type of fixture and material, and gives dimensions, etc.

338 Watertight Masonry — Major considerations in designing tight masonry walls are covered by The Master Builders Co. in 6-pp Bulletin O.M.-8A. Discussed are mortar ingredients and proportioning, compatibility of brick and mortar, control of shrinkage and bleeding, separation cracks, effect of mechanical disturbances.

339 Aluminum for Architecture — Comprehensive information on aluminum alloys and surface finishes is provided by Olin Mathieson Chemical Corp. in this 20-pp booklet. Contains guides to mechanical finishes, as well as descriptions of textures, bright or satin surfaces. Electrochemical and chemical finishes with recommended coatings for varying architectural exposures are listed. A section on applied finishes covers porcelain enamel, baked enamel and primers.

340 Grouting Methods — Effective methods for grouting the different basic types of heavy industrial equipment are explained with text and photos by The Master Builders Co. in 8-pp Bulletin EPMG-2A. Advantages of the pre-mixed grout are explained, and diagrams, charts and photos cover preparatory steps, forming, selecting materials, mixing and placing grout.

341 Masonry Fasteners — Fifty-pp pocket-size Catalog 160 of Diamond Expansion Bolt Co., Inc. lists anchors and fasteners for masonry and hollow walls. Covers machine screw anchors, lag screw expansion shields, machine bolt expansion shields, closed back machine bolt expansion shields, masonry drills, and a variety of anchors. Fully illustrated, includes application information, size data.

342 Seals and Fasteners — Sixteen-pp Catalog 359A covers high-pressure, vibration-resistant seals and fasteners of A.P.M. Corp. Tabular data, specifications, brief descriptive text and engineering drawings are provided. Products covered include Hexseals, Seelskrews, Seelbolts, and Seelrivits. RubRglas-Seel transparent and flexible wide-angle boots for sealing circuit breakers and indicator lights are also described, as are miniaturized and ruggedized armored power connectors.

343 Water-tight Sealant — Physical properties and characteristics of A. C. Horn Companies' two-component synthetic rubber compound based on liquid polysulfide polymer for use in sealing joints where an absolutely water-tight seal is required are detailed in 16-pp Bulletin 6543. Lists advantages.

Another Reference File of Commercial Literature is in preparation and will appear in a few months. The editors welcome your suggestions for making this department of greatest value to you

344 Handbook on Waterstops — In the 24-pp Kwik-Seal Waterstop Technical Manual of The Gates Rubber Co. is a wealth of practical information on waterstops and their use. Covers sizes and shapes of the waterstop, comparative data for rubber and plastic types, handling and storage of the material, design data for both "little" and "considerable" movement joints, application data for installation, and splicing methods.

Handling Equipment

345 Custom Cranes — Twelve-pp Bulletin 5000-B of Conco Engineering Works describes and illustrates electric and hand operated overhead traveling cranes, jib cranes, hand hoists, I-beam trolleys and special equipment. Covers in detail custom-engineered overhead electric traveling crane bridges and electric trolley hoists.

346 Cranes, Hydro Equipment — Cranes and equipment for hydroelectric, water supply and other applications are described in 12-pp Brochure HY-51 by Yuba Consolidated Industries, Inc. Various components and assemblies that help harness hydroelectric power are pictured, including cranes and hoists, gates and valves, and special hydroelectric equipment.

347 Material Handling Equipment — Described in Whiting Corp.'s 16-pp Bulletin 246 are overhead travelling cranes, monorail and crane systems, vacuum handling systems, and Trackmobile, the road and rail freight car mover. Photos show installations.

348 For Overhead Handling — Illustrated and described by Manning, Maxwell & Moore, Inc., in 20-pp Bulletin 15025 are hoisting products for overhead load handling. Included are descriptions of electric hoists, air hoists, chain blocks and hoist accessories, lever operated hoists, chain blocks, electric and air operated cable type hoists, and lifting specialties.

349 Mechanical Vibrating Conveyors — Catalog 954 of The Jeffrey Mfg. Co. discusses operation and features of mechanical vibrating conveyors. Four types to meet a wide range of applications are presented in detail in this 64-pp book. These include a heavy duty conveyor; a medium-duty, medium-weight conveyor; a low-capacity, low-height unit: and dynamically balanced type for use on upper floors, tops of silos etc.

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350 **Flexible Handling System** — Twelve-pp Bulletin 430 of The Frank G. Hough Co. is devoted to the Payloader system, adaptable to one specific application or many uses, for full-time handling of one material or many materials, or for part time jobs. Illustrated case histories cover use of Payloader trucks in a wide range of industries. Specifications are tabulated for gasoline and diesel engine powered models.

351 **Why Battery Trucks** — Purpose of this 20-pp booklet is to present major features of construction and operating characteristics of battery-electric industrial trucks, and to show what users say about their advantages. Operating economy, low maintenance, safety and other factors are covered. Booklet is offered by Electric Industrial Truck and Allied Products Manufacturers.

Firing Equipment

352 **Oil, Gas Burners** — In Bulletin G59, The Engineer Co. describes a combination gun-type gas and steam-atomizing oil burner unit. Features and advantages detailed.

353 **Firing Equipment** — In 12-pp Catalog 6260 Iron Fireman Mfg. Co. covers automatic firing equipment for heating, processing and power, including oil burners, gas burners, dual-fuel burners for gas and oil, forced draft package units, boiler-burner units, coal stokers, factory-wired combustion control panels, etc. Index and selection chart simplify equipment choice.

354 **For Burning Refuse Fuel** — This 8-pp bulletin of Riley Stoker Corp. describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuel such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses components.

355 **Spreader Stoker** — Advantages and features of Detroit Stoker Co.'s continuous ash discharge spreader stoker are detailed in 24-pp Bulletin 40. Illustrates and describes operation details, and includes diagrammatically illustrated specifications, schematic diagrams showing installations with various types of boilers.

356 **Water-Cooled Stoker** — Design and operating advantages of the Vibragrate Stoker are outlined by American Engineering Div., United Industrial Corp. in this illustrated bulletin. A cutaway details components and explains operating features.

357 **Pump and Heater Sets** — Bulletin 15, Walter H. Eagan Co., Inc. describes packaged fuel oil pump and heater sets designed for accurate control of temperature and pressure of heavy oils to insure proper atomization and combustion. Features are described and data presented.

Maintenance, Shop Equipment

358 **Heavy-Duty Electric Tools** — Twelve-pp Condensed Catalog G20 illustrates and describes heavy-duty electric tools, including drills, saws, shears, hack saws, generators, grinders, hammers, screw drivers, nut runners, sanders and polishers. Detailed specifications are included. Milwaukee Electric Tool Corp.

359 **Tips on Grinding Wheels** — Over 1600 abrasive wheel recommendations for grinding everything from agate to zirconium are set up in alphabetical order by The Carborundum Co., in this specification catalog, about 57-pp. Material, work, operation — with their respective recommendations on abrasive, grit, grade and bond — are listed.

360 **Guide to Preheat** — Welding of low-alloy high-tensile steel and other alloy steels with the aid of preheat is explained by J. B. Nottingham & Co., Inc., in 40-pp "A Guide To Preheat". Physical and chemical changes that take place in these problem steels during and immediately after welding are outlined.

361 **Safety Tools** — Non-sparking-safety hand tools for use wherever inflammable gases, explosives or other hazardous conditions are present are described in 24-pp Bulletin ST-10d of Ampco Metal, Inc. Describes over 400 items for almost every type of hazardous condition.

362 **Grinding Wheel Chart** — Information contained in this chart is based on rules and regulations established by the American Standard Safety Code for use, care and protection of abrasive wheels. Prepared by the Grinding Wheel Institute, it lists "do's and don'ts" of grinding wheel care.

363 **How to Bend Conduit** — This 12-pp pocket-size booklet of Appleton Electric Co. gives instructions for making precision bends in electrical metallic tubing, rigid steel, and rigid aluminum conduit. Covers five fundamental bends — angle bends, stub lengths, back-to-back bends, offsets and three-bend saddles. Diagrams show techniques for on-the-spot bending of small conduits. Includes offset formulas, shrink tables and "gain" tables.

364 **On Welding Electrodes** — Contained in this 64-pp electrode pocket guide is information on all types of electrodes including mild steel, low alloy, low hydrogen, iron powder, stainless steel, hardfacing, non-ferrous and cast iron. Published by Air Reduction Co., Inc., it covers applications, procedures and pertinent data on each electrode, includes charts of recommended electrodes for welding various steels, and tables for mild steel and hardfacing electrodes.

365 **Equipment for Welding** — Gas welding, cutting and allied equipment of Smith Welding Corp. is covered in this 40-pp manual. Book is arranged in six sections and with it is a 6-pp full-color insert showing cutaways of major products. Charts and technical data are also provided. One section is devoted to flow capacity curves for gas pressure regulators.

366 **Manual Welding Equipment** — Described in 20-pp Catalog F-8982E is Linde Co.'s manual welding equipment using an inert gas to protect the weld zone from the atmosphere. Various types of welding torches and accessories suitable for welding of all commercial metals are covered.

367 **Soldering Irons** — Publication GED-3553, 8-pp, describes and illustrates General Electric Co.'s soldering irons featuring lightweight, calorized and ironclad tips and tubular heater. Case histories of typical users included.

368 **Hand Torches** — Illustrated in 36-pp Form A DC-702E of Air Reduction Co., Inc. are gas welding and cutting hand torches, outfits, tips and accessories. General descriptions of various types of torches are included with data on features, as well as specification charts on welding and cutting tips for general purpose and special applications.

369 **Maintenance Equipment** — Catalog No. P-9, 24-pp, contains descriptions of pulling systems, photographs showing Grip-o-matic and push-pullers, Power-Twin "center hole" rams, pumps and hydraulic shop presses offered by Owatonna Tool Co. Shows how these units remove and install gears, bearing, pulleys, shafts and couplings simply and quickly. Heavy duty industrial wrenches are also described.

370 **Manual Hardsurfacing** — Basic information for manual hardsurfacing is contained in 12-pp Bulletin 3100 of The Lincoln Electric Co. Discusses economics and metallurgy of hardsurfacing, analyzes various conditions which demand hardsurfacing, and provides information concerning electrode selection and procedures which will produce surfacing desired.

371 **Flame Spraying Processes** — Basic engineering and application data on flame-sprayed coatings of metals, ceramics, carbides and other high melting materials is presented in 16-pp Bulletin 136B by Metallizing Engineering Co., Inc. In addition to covering basic engineering considerations for each process, it includes tables and charts covering the specific characteristics of each.

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Automation, Instruments and Controls

372 Automatic Controls — Comprehensive data on mercury-switch equipped controls for single-stage pressure, two-stage pressure, differential pressure, single-stage temperature, two-stage temperature, liquid level and mechanical movement are presented by The Mercoid Corp. in 56-pp Catalog 860. Each control with accompanying description, specifications and engineering data is indexed by product name and type number.

373 Industrial Controls — This 88-pp catalog presents comprehensive information on controls, offered by General Controls Co., including automatic temperature, pressure, level and flow controls, as well as counters, switches and automation controls. Other items described are industrial actuators, combustion instrument controls, controller indicators and pressure indicators.

374 Temperature Controls — Filled with charts, drawings and diagrams, 24-pp Bulletin 101, of the Partlow Corp., discusses industrial temperature measurement and control, including ways of responding to temperature, ways of putting temperature response to work, mercury-bulb instrumentation, basic types of controls, and a score sheet for the mercury-bulb system. Also covers basic concepts of electrical, pneumatic and mechanical controls.

375 On Thermocouples — Detailed information on thermocouples and thermocouple components and accessories is contained in 50-pp Catalog EN-82 of Leeds & Northrup Co. Lists and describes standard assemblies in protecting tubes and wells for general applications; specialized thermocouples and assemblies; and bare and insulated thermocouple wires, replacement elements, ceramic insulators, metal and ceramic protecting tubes, wells, terminal heads and extension leadwires.

376 How to Select Recorders — Buying information on recording instruments of General Electric Co. is provided in 12-pp Bulletin GEA-6933, including dimensions and chart speeds, operating specifications, applications, features and accessories. Recorders are grouped by accuracy class. Also described are specialized recording instruments — recording vibrometers, automatic oscillographs, self-balancing potentiometers.

377 Mass Flowmeter — Bulletin GEA-6925, 8-pp, describes theory, operation and advantages of General Electric Co.'s flowmeter that measures flow of fuels, industrial liquids, and gases directly in pounds. Includes ranges, specifications and dimensions, and drawings illustrating operation of the instrument.

378 Unit Ventilator Control — Described in this unit ventilator control application manual, about 88 pp, are Barber-Colman Co.'s automatic control systems for hot water, steam, gas-fired and electric unit ventilators. Control applications are shown on each page, covering makes and models marketed by major unit ventilator companies. Complete cycles of operation, damper sequence charts, specifications for precise temperature control and installation data included.

379 Leak Detector — Instructions on use of halogen leak detectors for finding leaks in enclosures that can be pressurized, in such applications as steam boilers, valves, piping, transformers, air-conditioning and refrigeration equipment are given by General Electric Co. in Bulletin GET-2936, 6 pp. Discusses system preparation, testing procedures, quantitative measurement techniques, and calibration.

380 Rotameters, Flow Indicators — Condensed Bulletin M-1 features Schutte and Koerting Co.'s instruments for measuring, indicating, recording and controlling rate of flow of all types of fluids. Various rotameters are described, also flow indicators for installation in pipe lines where it is necessary to see that fluid is flowing in right direction and in proper state and condition.

381 Test Instruments — Catalog G-10 contains 48 pp of detailed information on scientific measurement, recording, and testing instruments of Minneapolis-Honeywell Regulator Co. Among those covered are d-c amplifiers, data handling systems, calibration instruments, magnetic tape instrumentation, nuclear instrumentation, oscillographs, recorders and indicators, servo components, temperature controllers and transducers.

382 Pressure Gages — Featured by J. E. Lonergan Co. in 46-pp Catalog 1000G are pressure indicating and vacuum gages for industrial, chemical, and refinery applications. Selector tables give data on various gages and recommended services. Specifications, standard graduation tables, photos, and dimensional diagrams included.

383 Hydrostatic Instruments — In this 88-pp pocket-size handbook of hydrostatic instrumentation, Petrometer Corp. includes information on principles of hydrostatic measurement, selection and installation of instruments, design and construction of panel systems, as well as engineering data and diagrams. Provides tank volume formulae, conversion tables, viscosity charts, hydrometer scales, specific gravity tables for various liquids.

384 Air Meters — Catalog 170 describes air velocity, flow, pressure and vacuum measuring instruments operating on the compensated thermopile principle of Hastings-Raydist, Inc. Basic circuit of compensated thermopile shown.

385 Water Level Gages — Twelve-pp Bulletin WG-1815 described Yarnall-Waring Co.'s color-port gages for medium boiler pressures to 1050 psi, and high pressures to 3000 psi. Details of gages, water columns, color-port inserts, and gage valves are given, with dimensions, data on transmittal of readings, and servicing instructions.

386 Guide to Gages — Catalog 300-B, 112 pp, features Ashcroft, Dura-gauges, Maxisafe, pneumatic receiver, recording, drawn case, chemical and special application gages of Manning Maxwell & Moore, Inc. Also presented are gage testers, pneumatic transmitters, gages for nuclear energy. Engineering data and charts are provided. Instruments shown cover dial sizes from 2 through 24 in.

387 Nuclear Instrumentation — Detailed information on nuclear instrumentation and accessories is presented in 50-pp Condensed Catalog F of Tracerlab, Inc. Covers all phases of nuclear study and includes detectors, counting and radiation analysis equipment, sample changing equipment and necessary adjuncts for personnel protection, monitoring and handling.

388 Motor Operators, Valves — Catalog 407, 24 pp, describes electric motor operators and motorized valves of Schade Valve Mfg. Co. and introduces the Type 2RD, a reversible, proportional unit. Fully illustrated, booklet covers features, construction details, applications, dimensions. Valves described include butterfly, rotary disc, balanced globe, three-way, fuel control, others.

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389 Automatic Controls — Selection and application information on automatic controls for steam and water service is presented by The Powers Regulator Co. in this 46-pp Engineer's Manual. Covers controls for fuel oil heaters, heat exchangers for cooling, instantaneous heat exchangers, jacket water cooling, process hot water, pressure reduction, storage heaters, as well as for two temperature hot water systems.

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390 Control Centers — Described in 22-pp Bulletin C11, Webster Engineering Div., Midland-Ross Corp., are control centers and systems for combustion safeguard and automation. Advantages of custom engineered control centers and systems are covered, and design data and starting sequence on nine typical installations included.

391 Computer Control System — Details on PowrMag solid state analog computer control systems are presented in Bulletin MSP-163, Hagan Chemicals & Controls, Inc. Provides diagrams showing interchangeable circuits possible for various control functions. Applications to industrial process control are suggested, with emphasis on centralized plant or multiplant control, expansion of facilities.

392 Automation through Modernization — A guidebook to automation for the metal rolling and processing industry is offered in Catalog GED-3893 of General Electric Co. Describes step-by-step approach to automation, covering five basic areas of operation — reversing hot mills, hot-strip mills, cold mills, processing lines, and specialized processes.

393 Compiler-Translator — Act I, an electronic algebraic compiler and translator, is described in 18-pp Manual S-520 of Royal McBee Corp. Explains "source" program language — a series of algebraic and logical statements. Stresses simplicity of use, faster programming and thus faster computer solutions to engineering and control problems.

394 Teaching Servo Systems — A new method of teaching servo systems that bridges the gap between theory and practice is described in 8-pp Special Report SR-3 by Servo Corp. of America. Explains how packaged assembly of electronic and electrochemical components permits students to build and test servo systems, demonstrates formula derivation, characteristics of control systems.

395 Data Processing at Work — Data processing equipment of Leeds & Northrup Co. now in use throughout the country is described in 48-pp Preliminary Technical Publication N-07(1). Installations covered include digital data processing and analog and digital computing systems. Explains types of inputs, input switching, output devices and modes of operation for applications in electric power, petro-chemical, other fields.

396 Indicating-Alarm System — Features and advantages of the Omniguard indicating and alarm system by Thomas A. Edison Industries for monitoring temperatures and pressures are illustrated and described in Publication 3036C. Includes data on selecting parts for a complete Omniguard system.

397 Modulator Lamp Systems — Features and operational details of modular industrial lamp annunciator systems for supervision: process control, automation systems are presented in 24-pp Bulletin A-200 by Edwards Co., Inc. Several models of lamp annunciators are covered, also relay cabinets and audible signals. Includes system selector chart.

398 Annunciator Systems — Well illustrated with photos, charts and diagrams, 52-pp Catalog 100C of the Panalarm Div., Panellit, Inc., presents information on annunciator systems designed to give immediate notification of off-normal conditions in continuous process and automatic operations. Discusses function and applications of annunciators and types of equipment.

399 Remote Indication Logging — Application of automatically programmed remote indication logging system for operation in conjunction with its space-code selector supervisory equipment is told in General Electric Co.'s Bulletin GET-2925, 8 pp. Includes information on coding; master and remote station components; adding to existing systems; physical arrangements, control power, operating voltages and channels.

400 Data Logging System — Technical data on all functions of the Kybernetes Series 2000 Data-Logging System are presented in this 12-pp bulletin by Hagan Chemicals & Controls, Inc. Covers inputs, d-c amplification, analog-to-digital conversion, linearization, programming, integration, computer control and others. Specifications for components and functions of system included.

401 Annunciator Systems — Comprehensive information on operation and application of annunciator system to provide continuous and automatic surveillance of pipeline, chemical and food processing, power generation and distribution is given by The Scam Instrument Corp. in 36-pp Catalog 659. Types of annunciator sequences are illustrated and described, annunciator diagrams included.

402 Signaling Equipment—Air and electric signal systems and specifications of horns, bells, buzzers, chimes and sirens are featured in 88-pp Catalog 160 by Sperti Faraday, Inc. Included are sections on gravity drop and lamp type annunciators and accessory equipment, and charts and diagrams for selection of proper type signal for various background noise levels and work areas.

Safety, Fire Protection

403 Personal Safety Equipment — Catalog 59, 76-pp, of Wilson Products Div., Ray-O-Vac Co., covers four general types of personal safety equipment: eye protective wear; respiratory protection; hearing protection; and headgear. Detailed product descriptions show individual components and parts and charts recommend specific equipment for each hazard.

404 For Fire Protection — Folio 1 of Chemetron Corp.'s Cardox Div., is a 12-pp revised booklet on fire extinguishing systems and equipment. Lists principal causes of large-loss fires, advantages in use of carbon dioxide, and examples of extinguishing installations in steel, general manufacturing, electrical and other industries. Shows typical systems for protection of generators, flammable liquids, pumping operations, etc.

405 Fire Alarm Systems — Publication 246 of The Standard Electric Time Co. contains 36 pp of detailed information on fire alarm systems for critical applications in industrial, institutional and other public buildings. Contains typical job specifications covering all systems.

406 Handling Flammable Liquids — Problems involved in use of flammables and methods and equipment required for safe control are described by The Protectoseal Co. in this 76-pp safety handbook. Physical properties and characteristics of most commonly used flammables are detailed, and recommendations for safe handling of these liquids given.

407 Fire Extinguishing Equipment — Shown by Ansul Chemical Co. in 20-pp Catalog 1960 are hand portable extinguishers, stationary fire equipment, piped systems, and large capacity mobile equipment such as fire jeeps and trucks. Capacity data on various types of extinguishers and other equipment presented.

408 Fire Control Tips — This fire control chart, AD3003R8, shows fire extinguishers and gives detailed information including ratings. Prepared by Walter Kidde & Co., Inc., gives data on Class A, B and C fires and extinguishers suitable for each class of fire.

409 Special Fire Protection — Devoted to special hazard fire protection, this 44-pp booklet of Grinnell Co., Inc. covers both equipment and methods. Tells how to recognize special fire-hazard conditions in a plant. Discusses in detail major types of fire protection, telling how each functions, giving it advantages and limitations, and illustrating examples of use.

410 Chain Safety Kit — Answers to questions regarding the care, use and inspection of sling chains are given by The McKay Co. in this safety kit. Consisting of five folders, each dealing with a different aspect of chain safety, it covers inspection procedures, safety cautions, safety terms, working load limits, proper care and use of chain, and maintenance procedures.

411 Safety Color Code — This color-illustrated folder of McDougall-Butler Co., Inc., covers national color identification system for safety promotion through equipment identification. Paint finishes are also described.

412 Color for Safety — Offered by Valdura Heavy-Duty Paint Div., American-Marietta Co., this 6-pp booklet shows a cutaway section of a typical industrial plant with all danger areas painted in appropriate safety colors. Lists recommended colors for every safety application, and gives tips on good housekeeping.

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413 Fire-Retardant Paints — Twelve-pp pocket-size Bulletin 100 of The Albi Mfg. Co., Inc., tells how fire-retardant paints reduce potential fire damage. Explains significance of the "safety margin" of extra time at start of a fire as related to protective action of the paints on both combustible building material and structural metal.

414 Self-Sticking Identification — Products designed to aid in industrial maintenance and safety identification programs are illustrated and described in 32-pp Catalog 520 of W. H. Brady Co. Covers piping marking systems, identification of plant wiring and electrical equipment, lubrication marking, marking for hazardous areas and equipment.

Maintenance Coatings and Cleaners

415 Coal-Tar Coatings — Bulletin CAC-11-958, 14-pp, describes coal-tar protective coatings of Plastics & Coal Chemicals Div., Allied Chemical Corp. Primarily moisture barriers and impervious corrosion proofers, these coatings are particularly suitable for buried or immersed steel and concrete structures. Booklet lists specifications, resistance properties and typical industrial applications for expanded cold-applied coal-tar coatings.

416 Maintenance Coatings — Described in this 16-pp bulletin are protective maintenance coating systems designed by The Glidden Co. to solve a variety of application problems. Index tab indicates where a particular system should be applied, and copy explains features of each system, suggests uses, mentions colors available.

417 Corrosion Resistant Coatings — Latest developments in corrosion resistant coatings, treatments for floors, and coatings and waterproofing for masonry are described in 72-pp Form 990 of Truscon Laboratories Div., Devoe & Raynolds Co., Inc. Presents detailed information on maintenance products available for interiors, floor coatings, exteriors, new construction, other uses.

418 Protection Against Rust — This 38-pp treatise (Form 259) on rust and corrosion control by protective coatings shows actual color standards of Rust-Oleum Corp.'s primers and top coatings. Covering water resistant, heat resistant, floor coatings, heavy-duty chemical resistant coatings, galvanized metal coatings, wire fence roller coatings, and quick-dry coatings. Bulletin contains full-color application photos and 110 color chips, and technical section giving data on surface preparation for various types of surfaces, application techniques, how to estimate gallonage needed, other information.

419 Efflorescence, Chalking — Causes of efflorescence and early chalking on painted masonry surfaces, and ways to overcome and prevent such deterioration are explained by Rohm & Haas Co. in this 48-pp booklet. Discusses paint formulation and compares four major types of emulsion vehicles for resistance to alkali, moisture, heat, and ultra-violet light. Also covers film swelling, film coalescence, paint stability in presence of soluble salts, pigmentation, pigment volume concentration.

420 Protective Coatings — Described by Pittsburgh Coke & Chemical Co. in 8-pp Form PC-50 are industrial protective coatings for specific applications. Characteristics of coal tar-epoxy resin coatings, Gilsonite-asphalt matics, and cold applied coal tar coatings and application methods are described and advantages detailed.

421 Coatings for Industry — Detailed information on coatings for industrial application, including anti-corrosive coatings, decorative finishes, exterior wall and roof coatings, floor materials, fungus and mold treatments, industrial coatings, interior wall coatings, roof coatings, and other products is presented by Steelcote Mfg. Co. in 40-pp Catalog 59. Properties are covered.

422 Painting Galvanized Steel — Effective techniques for painting galvanized steel sheets are explained in this 16-pp booklet, produced jointly by the American Iron and Steel Institute, the American Zinc Institute, and the National Paint, Varnish and Lacquer Ass'n. Discusses main reasons for this painting: appearance, heat reflection, longer service. Provides tips on selection and application of paints, other data.

423 Masonry Treatments — Waterproofing, protective and corrective treatments for masonry are described by Standard Dry Wall Products, Inc. in this 22-pp specification guide. Circular 17 describes products and their applications, includes photos of typical applications, and suggested specifications.

424 Insulation Coating — Form L-17 presents advantages of J. W. Mortell Co.'s No-Drip insulation coating for preventing condensation drip from metal, concrete, brick, wood, plaster, or composition surfaces. Lists applications.

425 For Chemical Cleaning — Technical Bulletin 102, about 16-pp, presents application and other information on products of Chas. Pfizer & Co., Inc. for chemical cleaning. These include formulas for power plant cleaning, stainless steel cleaning, aluminum and aluminum alloy cleaning, alkaline derusting and paint stripping, general cleaning, others. Also provided is chart of corrosion rates.

Lighting

426 Floodlight Data in Brief — Pocket-sized Bulletin 2714 is a 184-pp miniature edition of Crouse-Hinds Co.'s floodlight catalog, and includes all original material. Covers selection of floodlights, general purpose floodlights, heavy duty models, mercury vapor floodlights, special types, lighting for hazardous locations, searchlights, poles, accessories. Includes installation suggestions and lighting calculations.

427 Area Floodlighting — Planning for lighting of parking areas and other open areas is detailed by Crouse-Hinds Co. in 16-pp Bulletin 2719. Contains reference guides for selecting incandescent or mercury floodlights, general purpose or heavy duty types, and for determining how many floodlights are needed based on size of area, as well as footcandle charts, installation diagrams.

428 Aluminum Floodlights — Catalog S, 8-pp, gives condensed data on cast aluminum outdoor floodlights of Stonco Electric Products Co. Covers new decorative outdoor bullets, medium and mogul base floodlights, high intensity Power-Beams, emergency portables, wiring troughs splice boxes, outdoor fittings, and fixtures designed for vaportight service.

429 Incandescent Lighting — The 24-pp "Incandescent Lighting Guide Book" of Sylvania Electric Products Inc., features sections on the general advantages of incandescent lighting, the history of incandescent lamp developments, and includes chapter on basic types, bulb shapes, sizes, glass types and finishes, and bases.

430 Group Relamping Plan — Eight-pp Booklet A-6832 describes a group relamping plan designed by Westinghouse Electric Corp. to reduce costs, provide better lighting, and cause fewer work interruptions. Sample calculations provide data for setting up a schedule.

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431 Lighting Maintenance Tips — Principles and advantages of good lighting practice are presented in Champion Lamp Works' 48-pp lighting maintenance manual. Includes guide to trouble shooting fluorescent installations, a section on planning group replacement of lamps, cleaning.

432 Vapor-Tight Fixtures — Presented in this 52-pp catalog supplement of Killark Electric Mfg. Co. are vapor-tight aluminum lighting fixtures. They include pendant, ceiling and bracket types for a variety of installations. Reflector styles — shallow bowl, standard dome or angle — are also described, and information on accessories available.

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433 Lamp Ballast Service — Described by Universal Mfg. Corp. in this product bulletin is a service program for fluorescent lamp ballasts which provides immediate replacement of inoperative ballasts. Also described is a 24-hr engineering service for design consultation, installation assistance or trouble-shooting.

434 Miniature Lamp Data — This 24-pp pocket size booklet of Chicago Miniature Lamp Works lists standard miniature lamps now available, and the sources of supply from which they may be obtained. Specifications of the lamps (nearly 400) are given as well as lamp nomenclature with drawings of styles.

Dust Control

435 Dust Collection, Recovery — A series of product bulletins on Western Precipitation Corp.'s dust collection, precipitation and gas scrubbing equipment is provided in this literature folder. Equipment described includes electrical precipitators, mechanical dust collectors, gas scrubbers, high temperature dust collector, reverse-jet equipment, rapper control, fly ash collector, transistomatic precipitator control.

436 Dust Collectors — Included in 16-pp Bulletin 1828, American-Standard, is a list of typical industry dust control applications . . . for power plants, steel production, cement and aggregate production, chemical and petroleum processing, food and grain processing and general manufacturing. Covers operating characteristics, construction features, and includes nomogram presentations designed to simplify engineering calculations, assembly arrangements, line drawings.

437 Electronic Air Cleaner — Twelve-pp Bulletin 405, Dollinger Corp., describes features and advantages of an electronic air cleaner based on the principle of electrostatic precipitation. Diagrams, photos and specifications are included.

438 Freedom from Dust — In Bulletin 805, 28-pp, Dracco Div. of Fuller Co. describes dry collection equipment showing ways of using cloth filtration and cyclonic equipment for eliminating dust control and air pollution problems. Covers Multi-Bag filter, Uni-Filter, Glass-Bag filter and Whirl-Clone, also special collectors and accessories. Illustrated application data shows use of these to collect waste dust, reclaim reusable material.

439 Mechanical Dust Collectors — Recent improvements in mechanical dust collectors including a new involute design are described in 8-pp Bulletin 300 of Research-Cottrell, Inc. Contains detailed drawings and application diagrams.

440 Unit Air Filters — Construction and application of permanent washable unit air filters is detailed in 12-pp Bulletin 207 of American Air Filter Co., Inc. Covers filter maintenance methods and equipment, installation data, and includes charts, arrestance-resistance curves, dimension drawings.

Water Management

441 Ultrapure Feedwater — Technical Reprint T-178 of Graver Water Conditioning Co. covers research problems relating to production and quality control of ultrapure feedwater for Eddystone Station. Presents pilot plant data on filtration and demineralization process for treating condensate and specific plant-scale design features are described as well as analytic ways to measure condensate quality.

442 Sodium Zeolite Softeners — Described in 12-pp Bulletin 4520 by Cochrane Corp. is the sodium zeolite process of water softening. Includes information on selecting and sizing of equipment, automatic vs manual controls and calculations of softening capacity.

443 On Zeolite Softeners — "Care and Operation of Zeolite Softeners" covers bacterial fouling, deposits encountered and operational factors in relation to this equipment. Prepared by Betz Laboratories, Inc., it tells too, how exchange material should be handled to maintain maximum efficiency and longer equipment service life.

444 pH and Chlorine Control — The 14th edition of W. A. Taylor Co.'s handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrate, sulfate, hardness and other tests. Slide comparators and test kits are illustrated. Methods are also outlined for quantitative analyses of phosphate, calcium, magnesium, silica, nitrate, hardness. Available to qualified power engineers, please state your job title.

445 How Corrosion Attacks — In this data sheet, Betz Laboratories, Inc., explains how and why boiler, cooling and process water systems are constantly plagued by corrosion. Discusses such factors as pH, dissolved solids, temperature, flow rate, dissimilar metals, CO_2.

446 Boiler Water Treatment — Chemical reduction of oxygen in boiler feedwater with hydrazine is the subject of 10-pp Bulletin BW of Fairmount Chemical Co., Inc. Economy and operation, handling of the Deoxy-Sol, methods of analysis and other details are covered.

447 Deaerating Heaters — In 8-pp Bulletin WC-101C, Graver Water Conditioning Co. discusses principles of deaeration, deaerator operation, standard designs available, design features and accessory equipment. It is illustrated with drawings and photos of installations.

448 Corrosion Control Method — This data sheet of Betz Laboratories, Inc. discusses Dianodic method of corrosion control and its use in open recirculating cooling water systems. Variations of the Dianodic method to meet specific requirements and cope with variables that enter into corrosion problem are covered.

449 Automatic Treatment Control — Methods for automatic control of water treatment plants are discussed in 8-pp Technical Reprint T-179 by Graver Water Conditioning Co. In two parts, Part I deals with control of demineralization plants and covers "stepless" regeneration, regeneration, quality control of effluent, conductivity pH control, automatic regeneration. Part II considers control of cold process softening and clarification units, hot process-hot zeolite systems and sodium zeolite systems.

450 Treatment Instrumentation — Provided in 30-pp Booklet D97-2 of Minneapolis-Honeywell Regulator Co. is a compilation of article reprints on instrumentation for treatment of water and sewage. What instruments are used, how they are used and their functions in controlling automatically the many variables encountered in the treatment process are covered in detail.

451 Putting Effluent to Work — Use of sewage plant effluent for boiler and cooling purposes is discussed by Betz Laboratories, Inc. in Technical Paper 138. Tells how effluent can be used satisfactorily in recirculating cooling systems and as boiler makeup provided it is adequately treated to avoid organic growths, deposits and corrosion in cooling systems and foaming, carryover and ammonia corrosion in boiler and steam systems.

452 Water, Sewage Treating — Water, sewage and industrial waste treatment equipment of Link-Belt Co. is described in 20-pp Book 2617. Contains illustrations and photos of latest sanitary engineering equipment and shows flow diagrams of installations in typical water, sewage, and industrial waste treatment plants.

453 Perforated Metal Screens — Applications and specifications for Conidure pierced metal and Rima slit screens used for coal, chemicals, water filtration, sewage disposal etc. are detailed in 12-pp Bulletin C101 of Cross Perforated Metals Plant, National Standard Co. Shows typical screen assemblies and shapes, perforation and slit configurations; gives application principles, open area equivalents, chemical analyses.

To use Post Cards, circle item numbers of catalogs wanted

Piping, Valves and Fittings

454 Valve Selection Tips — In addition to cross indexing company's own line of valves with those of other manufacturers, The Ohio Injector Co.'s. Valve Buyer's Guide, 22 pp, contains a list of frequently used abbreviations, a valve trim chart, other data. A breakdown by valve material and pressure class, and classification by type, disc design, seating arrangement, stem operation, bonnet and end connection also aid in selection.

455 General Service Valves — Twenty-pp Bulletin E-165 is a guide to Everlasting Valve Co.'s valves for general services. Types, typical applications, construction and operating features are discussed. Generously illustrated with drawings, photos and cutaways, booklet includes dimensional data.

456 Valve Selection Data — Facts to keep in mind when selecting a valve for a specific application are detailed in Crane Co.'s 20-pp Bulletin AD-2016. Three principal valve types are illustrated and described, and cutaway views showing component features included.

457 Corrosion Resistant Valves — Detailed information on bronze, steel and iron valves, and valves made of corrosion-resistant metals and alloys is presented in 24-pp Form 186 by The Wm. Powell Co. Covers angle valves, check valves, gate valves, globe valves, liquid level valves, lubricated plug valves, needle valves, relief valves, sampling valves, steam jacketed valves and others.

458 Corrosion Resistant Valves — Relative ability of metals, plastics and synthetic rubbers used in Flo-Ball valves to resist corrosive effects of 390 fluids encountered in industry is detailed in this 8-pp booklet by Hydromatics, Inc. Tabulation permits a rapid estimate of aluminum, carbon steel, semi-steel and 316 stainless; Buna N, Neoprene and Viton A; Teflon, nylon and Kel-F.

459 Silent Check Valves — Described by The Williams Gauge Co., Inc. in Bulletin WH-654 are silent check valves featuring low frictional resistance. Tables list dimensional data and reasonable velocities for flow of water through pipe, fitting, and valves.

460 Check Valves — Details and specifications on check valves designed to eliminate water hammer and line surge are presented by Combination Pump Valve Co., in 20-pp Catalog 600. Typical installations are illustrated, and installation data, flow chart, and pressure-temperature ratings included.

461 Valve Data — Catalog 10-A contains 16 pp of information on bronze, iron and steel gate valves, bronze and iron globe and angle valves, bronze and iron check valves, asbestos packed iron cocks, bar stock valves, and parts available from American Chain & Cable Co.'s R-P & C Valve Div. Operating specifications, characteristics, sizes, ratings and illustrations are included.

462 Valve Materials Calculator — Preferred valve materials for different types of corrosives are shown in this calculator prepared by Hoke, Inc. It is designed as a guide to the selection of materials of valve construction, based on "substantial", "moderate", "questionable" or "inadequate" resistance to the chemical in question at atmospheric pressure and temperature. Also lists control products for handling corrosive fluids.

463 Stock Solenoid Valves — Solenoid valves available "off the shelf" from Automatic Switch Co. are presented in 16-pp Stock List and Selection Guide 506. Contains engineering information, simple selection data, illustrations and flow diagrams of two-, three- and four-way types, manual reset valves, special purpose valves and strainers. Prices are also provided.

464 Specifying Solenoid Valves — Included in Valcor Engineering Corp.'s 8-pp booklet on specifying solenoid valves are a description of various types of valve sealing; a discussion of mechanical specification criteria including application description, fluid characteristics, pressure, capacity, leakage, valve life, speed of operation, electrical and environmental specification criteria.

465 Check Valves — Applications, engineering features, operating principles, dimensions and weight reduction of one-piece cast steel tilting disk check valves are discussed in Catalog 12-Y, 12-pp, by Edward Valves, Inc. The valves are suggested for welded conventional and nuclear piping systems in 900-, to 2500-lb pressure classes, sizes from 6 to 20 in. Catalog includes ratings, flow index table, curves, test results, and valve material specifications.

466 Supports for Piping — Described in 96-pp Catalog 59, is a system utilizing pre-engineered standard components in almost infinite combinations to solve most piping and equipment support problems. The system, introduced by Bergen Pipesupport Corp., affords savings in engineering and field costs, eliminates detailed hangar drawings and offers simplicity of use. Book also gives details on constant support hangers; roller devices; variable supports; light duty and cushion-spring hangers, sway braces; standard assembly parts and hardware, and hanger assemblies.

467 For Special Services — Specialty valves are covered in Catalog 59 of Atwood and Morrill Co., contains sections on free flow reverse current valves for turbines, refinery and other services; spring relief valves for steam and general services, atmospheric relief valves for condenser service; non-lubricated plug valves for general service, diaphragm operated and pressure regulating valves and by-pass valves, valves for special services.

468 Valves and Fittings — Twenty-pp Catalog R-7 of Superior Valve & Fittings Co. contains information on line valves, globe valves, relief valves, heat exchangers, check valves, SAE flare fittings and related brass products. Covers sizing and application of valves and components with data on working pressures and description of pertinent codes and regulations.

469 Ductile Iron Pipe — Properties and characteristics of ductile iron pipe combining mechanical strength of steel with the corrosion resistance of cast iron are detailed in this 20-pp bulletin of James B. Clow & Sons, Inc. Tables list physical and metallurgical properties of ductile iron pipe, compare its corrosion resistance in various media.

470 Power Process Piping — Piping systems fabricated and erected by Midwest Piping Co., Inc., for power stations and industrial plants are highlighted in 24-pp Bulletin 60B. Includes case-history stories of over 30 plants. Also includes section on weld fittings and flanges.

471 Good Piping Charted — Recommended piping practices are presented in this wall chart form by The Lunkenheimer Co. Chart is divided into five sections covering basic valve types, connections normally used, installation and maintenance tools, installation, operation and maintenance. Illustrations of valves, engineering specialties and lubricating devices appear on back.

472 Pipe Thread Fittings — Advantages of pipe thread fittings designed to eliminate positioning problems, leakage, and overtightening damage are detailed by the Tru-Seal Div. of Flick-Reedy Corp. in this product bulletin. Common types of positioning, distortion, alignment, reworking and leakage problems and their solutions are illustrated, and installation and dimensional data given.

473 Plastic Pipe, Fittings — PVC pipe, valves and fittings and their uses are covered in this 36-pp handbook by Kraloy Plastic Pipe Co., Inc. Specification, design and installation data are included, as well as a comprehensive corrosion resistance comparison chart of seven types of plastic pipe carrying 162 chemicals.

To order catalogs, use the Reader Service Post Cards

474 Guide to Strainers — Presented by Tate Engineering, Inc. in this 88-pp handbook on strainers is a compilation of reference data for layout of fluid flow systems and sizing of strainers, tabulated results of testings, and valve and pipe selection information. Reference material for each strainer section is on a fold-out page for use with any specific page in that section. Book contains over 100 illustrations of pressure drop, temperature, and viscosity charts in addition to engineering drawings.

475 Trap Strainers — Eight-pp Bulletin 601, Multi-Metal Wire Cloth Co., Inc., contains a chart listing case histories of typical trap strainer applications. Strainer size, materials of construction, metallic straining media, housings, screens, flanges, and connections for specific applications are listed.

476 Pipe Alignment Guide — This bulletin of The Align-O-Pipe Guide Co. introduces a device for guiding pipe lines which are expanding or contracting because of temperature changes. Explains how units permit movement of pipe line in an axial direction only. Discusses necessity for pipe alignment guides, benefits afforded by them, how to use them properly.

477 Markers, Signs — Illustrated in full color, this 24-pp catalog of North Shore Nameplate Div., Anodyne, Inc., provides information on pipe and electrical markers, numerals, letters, safety and identification signs all available from stock. Explains how markers are applied, also includes prices and information on ordering.

Packings, Seals, Gaskets

478 Mechanical Packings — Catalog P-210C, Raybestos-Manhattan, Inc. contains 40-pp of detailed information on mechanical packings and gasket materials. It contains illustrations, descriptions, complete service recommendations and specification charts.

479 Metallic O-Rings — Advantages of self-energized metallic O-rings designed to meet extreme conditions of temperature, pressure and corrosion are detailed in 30-pp Bulletin 596191A of United Aircraft Products, Inc. Illustrates and describes applications, sealing characteristics, and includes recommendations for correct use.

480 O-Ring Handbook — Catalog 5711 is a 24-pp design and data book of Parker Seal Co. on Viton O-rings. Contains test information on some 150 fluids and gases to which this synthetic elastomer is compatible; recommended design techniques; general information on three compounds and dimensions; and data on all standard sizes.

481 Packings, Gaskets — Palmetto gasketing and gaskets for flanges, joints, boiler manholes, furnace doors and similar applications are described and illustrated by Greene, Tweed & Co. in 12-pp Catalog GG-1259. Catalog presents 14 types of sheet packings; compressed asbestos ring and full face gaskets; wire inserted folded asbestos gaskets; six types of tape, rope, lagging and wick packings. Provides details on composition, temperature limits and intended services, prices.

482 Self-Lubricating Packings — This 12-pp catalog of Greene, Tweed & Co. tells what Palmetto self-lubricating packings are, and discusses their advantages on pump rods, shafts and valve stems. Describes four stranded forms. Provides quick calculator tables on weights, lengths and ordering suggestions. Each of 29 packing types is illustrated and described as to recommended service, uses, temperature limits, sizes, prices.

483 On Boiler Gasket Leakage — Some causes of boiler gasket leakage are discussed in Technical Paper 139 by Betz Laboratories, Inc. Factors to consider in overcoming or minimizing gasket leakage, such as selection of gasket joint, installation, and corrosion protection, are explained in detail.

484 Mechanical Packing Guide — Johns-Manville's 64-pp catalog, Form PK-131A, contains comprehensive information on mechanical packings and is generously illustrated. Includes chemical selection chart listing more than 700 liquids common to process industries. Also featured is a simplified packing selection chart to help relate particular operating conditions to the most suitable packing. A section of book is devoted to determining trouble spots.

485 On Retaining Rings — Forty-pp Catalog 1216, an engineering specification manual of Ramsey Corp., is said to cover 80 per cent of known retaining ring applications. Includes both Spirolox and improved Circolox ring specifications. Contains information on selection of materials and finishes, design factors, charts on rotative speeds, thrust loads and typical layouts for both internal and external ring applications.

486 Mechanical Seal — Performance and design features of Mechanipak PK mechanical seals for a variety of operating conditions are detailed by Garlock, Inc., in 8-pp Bulletin AD-150. Cutaway views, diagrams and tables of dimensional data included.

487 Corrosion Resistance Chart — Over 150 chemicals and their recommended usage with ductile iron, iron, steel 316 and 304 stainless steel, Monel, brass, bronze, copper, aluminum and plastisol plastic are listed in Corrosion Resistance Chart J-CRC. Prepared by OPW-Jordan Corp., chart shows which gasket materials are needed for various chemicals when Kamlok couplers are used and which O-ring materials are needed when swivel joints are used.

If the catalog you're looking for isn't listed here, please tell us about it. The chances are, we can get it for you

Cooling Towers

488 Double-Flow Aquatower — Bulletin DFA15-60 describes The Marley Co.'s double-flow Aquatower designed to bridge the gap between standard double-flow Aquatowers and unlimited capacity industrial cooling towers. Specifications and engineering data included.

489 Cooling Tower Economies — Presented by Hamon, Inc. in this 12-pp bulletin is a discussion of economic comparisons on cooling towers for a utility. Compares natural draft and mechanical draft towers to various approaches and includes detailed cost comparison curves, offers conclusions based on this data.

490 Cooling Towers — Performance details on cross-flow cooling towers of The Marley Co., are presented in this 20-pp illustrated Booklet CF-59. Discusses and illustrates through diagrams the cross-flow principle of water cooling, and includes descriptions of equipment, engineering and design features.

Tubing and Accessories

491 Tubes and Plates — Publication B-2, 46-pp of The American Brass Co., covers the subject of tubes and plates for condensers and heat exchangers. Field of application and particular problems encountered in each are described. Information on condenser tube alloys, plates for tube sheets and baffles, manufacturing methods, installation, operational factors affecting tube life, corrosion factors in condenser tube service is presented.

492 Tube Fittings Finder — Bulletin 4306-B1 offers condensed information on selection of proper fittings for various service and installation requirements. Includes shape charts for six types of industrial tube fittings and illustrations of tube-working tools produced by Parker Fittings and Hose Div., Parker-Hannifin Corp.

493 For Refinery Applications — Tube cleaning and tube rolling equipment for refinery applications manufactured by the Lagonda Plant, Elliott Co. is featured in 8-pp Bulletin Y-54. Illustrates and describes various types of tube cleaners and tube expanders and includes specifications.

Postage-free Reader Service Cards are on pages 119-120

MEMO:

to our readers . . . .

AVAILABLE HELP FOR PLANT PROBLEMS

Many outstanding articles published in Plant Engineering and Power Engineering have been reprinted to assist you in your everyday job problems. Following is a list of the available reprints with prices. Look this list over, decide which ones you want, fill in the coupon at the bottom of the page and send it to us with your check or money order.

Some of these reprints are in comparatively short supply so get your order in early.

Which one (ones) will serve you best?

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1	Atomics—48-page booklet of material which has been appearing in Power Engineering on atomic energy development throughout the world.	$1.00
2	Industrial Lighting—12-page manual covers lighting factors a plant engineer should consider. Discusses voltages, costs, etc.	0.50
3	Fluid Power Maintenance—48-page booklet on the selection, installation and maintenance of the various components of pneumatic-hydraulic systems.	0.75
4	Construction Cost Estimating—32-page, two color reprint of the time-savers series of articles recently appearing in Plant Engineering, covering all phases of estimating industrial construction costs—from floor slab to roof.	1.50
5	Effective Start-Up Engineer Smooths Out Preliminary Power Plant Operation—16-page reprint covers effective scheduling of start-up, checking of condensate, boiler feed and circulating water systems.	1.00
6	Construction Specifications—20-page reprint of five-part article on construction specs. Discusses what should be included in specs; payments, arbitration; construction bids; signing contract; progress report and final inspection. A copy of "General Conditions" will accompany the reprint.	2.00
7	Your New Industrial Power Plant—How to Get It Into Operation—24-page reprint of series of articles by Paul H. Garay from 1957 issues on building your new plant right and how to set up operating records.	1.00
8	What It Costs to Modernize Small Industrial Power Plants—24-page reprint of series of articles by H. D. Fisher from 1957 issues, giving six case studies of plants from 25,000 to 50,000 lb of steam per hour capacity.	1.00
9	Cherry-Hill—16-page reprint of article describing what construction pre-planning is necessary. Article discusses use of consultants, methods of bidding, basic concepts, selling the project to management.	0.50
10	A Power Plant Primer—32-page reprint of article by A. W. Kramer explaining the fundamental principles of the steam-electric power plant and of each unit of principal equipment, showing how they all operate.	1.00
11	Pumps—4-page reprint of article "Pumps—and Why They Have Troubles." Some of the points covered in article: sagging foundation, distortion of base plate, proper packing and its importance.	0.10
12	Construction Briefs—12-page booklets. Booklet No. 1—covers beam reactions, bending moment, moment of inertia and section modulus. Booklet No. 2—deflection, horizontal shear and floor loading. Booklet No. 3—columns, trusses and welded connection. Booklet No. 4—fastenings for timber; design of trussed roof and structural design. Booklet No. 5—Designing in Reinforced Concrete. Booklet No. 6—Design on Concrete Columns, Footings and Retaining Walls.	0.50 for each Booklet 1 to 4 0.75 for each Booklet 5 & 6

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494 Tube Cleaners — Bulletin G-515 of Elliott Co., Roto Plant, describes air, steam and water driven tube cleaners and accessories. Photos of the various types of cleaners are included, along with descriptive details and specification data.

495 Tube Cleaners, Expanders — Comprehensive information on maintenance tools for all types of tubular equipment is presented in 120-pp Catalog 77–88 of Thomas C. Wilson, Inc. Includes detailed suggestions on selection of tube cleaning equipment for various applications, data on condenser tube cleaners, vibrator cleaners for fire tube boilers, other boiler tube cleaners, water driven cleaners, vapor generator tube cleaners, wire brushing equipment, tube cleaner hose, lubricator, valves and manifolds, electrically driven cleaners, chipping and surfacing machine. Book is available to qualified power engineers, please state your job title.

Other Equipment

496 Cathodic Protection — Booklet describes corrosion control for buried or submerged piping, tanks, ships and similar structures. The company's consulting services, field surveys, design, installation and materials as well as general cathodic protection procedures are discussed in detail by Harco Corp.

497 Automatic Soot Blowers — Featured in Bulletin 897B by Diamond Power Specialty Corp. is a line of automatic soot blowers for fire tube and water tube heating boilers. Installation photos and diagrams are included, and advantages of applications of the soot blowers are detailed.

498 Engineering Data Tables — Bulletin 5311, released by Leslie Co., contains 12 pp of engineering data tables. Included are formulas for valve sizing, properties of saturated steam, steam flow in pipes, steam pressure drop determination, oil flow and viscosity data, properties of gases and liquids, piping data and fixture water flow, conversion factors. Also provided is handy chart covering selection of piping and valve materials.

499 Sheet, Plate Fabrication — A variety of parts and assemblies — from massive boiler breechings to smallest stamping — are illustrated in 40-pp. Bulletin F4, of The Kirk & Blum Mfg. Co. Facilities and equipment for production are illustrated, including shearing, contour cutting, punch press, large presses, brakes, welding, large and small structurals.

Reader Service Post Cards are on pages 119 and 120

EFFICIENCY 84.18%

Wiley & Wilson, Consulting Engineers
J. L. Hamilton Engineering Co., Installing Contractor

JOB: Supplying steam for space heat, hot water service, hospital needs, and refrigeration at Univ. of Virginia. Campus includes 100 buildings (approx.) plus 600-bed hospital.

STEAM GENERATORS: Two from Union carry the entire load. Recently installed, the one above is a Type VO two-drum unit (72,000 lbs./hr. continuous, 475 psi). Spreader stoker fired. Air heater supplied for heat recovery.

PERFORMANCE: One month's operating log for illustrated unit shows: 33,539,300 lbs. of steam generated. 1,382.5 tons of 14,243 BTU coal consumed. Average evaporation of 12.1 lbs. Max. 8-hr. load of 65,000 lbs. Max. 24-hr. load of 59,000 lbs. *Average efficiency for month — 84.18%.*

MORE FACTS: Many types and sizes of Union Steam Generators are covered in illustrated Bulletin GB-959. Write: Union Iron Works, Erie, Pa.

UNION

steam generators

For more data circle 556 on Post Card

Equipment News

Described on these pages are new and improved products. Use Reader Service Cards on pages 119–120 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—Final drive unit develops 400 lb-ft torque

Type 77MS is a pneumatic final drive unit introduced by Republic Flow Meters Co. to position valves, dampers and other control devices on heating and processing equipment. It is designed to develop up to 400 lb-ft of operating torque and 800 lb-ft stall torque with 45 psig air supply. Unit can be pneumatically or electrically controlled and covers the middle range of torque values. A characteristic cam relates per cent of drive lever rotation to per cent control signal change. Three cams — linear, square, and blank — are shipped with each unit, the blank cam to be field-shaped for special response. Accessories available are clevis, automatic air failure lock, combination air pressure reducing valve and filter, limit stops, limit switches, strip heater with thermostat, and position indicating quadrant with pointer. Bulletin 633.11 gives further information.

2—Ruling device draws arcs of large-radii circles

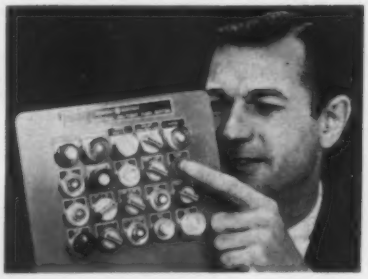
The Acu Arc Ruler draws arcs of circles of any radius from 7 to 200 in. or more with ease, according to Fullerton Engineering Sales Co., even if center point

of circle is beyond edge of drawing surface. Movable pointer on a scale reading radius length directly gives arc required. A chart is provided to convert radius readings to civil engineers scales.

3—Miniature push buttons take up less panel space

Reductions in panel space of at least 40 per cent are claimed possible with miniature industrial oil-tight push button units introduced by General Electric Co. Because of their smaller size — about half that of existing heavy-duty push buttons — these units require only a ⅞-in. diam mounting hole and may be as close as 1¼ in. apart.

The miniature types are said to offer mechanical and electrical life equal to company's heavy-duty oil line (within ratings) and the same operating and functional forms. These include push buttons (with or without guard); mushroom head buttons; selector switches; illuminated push buttons; illuminated mushroom head buttons; transformer-type indicating lights; and push-to-test indicating lights. Retaining rings in six colors permit easy color coding and engraved or blank nameplates come in two



sizes. Illuminated forms come in six colors, and encapsulated transformer for the lights has separate, insulated secondary winding for added protection. Manufacturer says that all of the miniature units are suitable for use in dirty environments, and that the line meets applicable NEMA, NMTBA and JIC standards. Units are rated at 150 v a-c.

4—Dry-type transformers are easy to install

Designed specifically for indoor use, these general purpose, ventilated, dry-type transformers in ratings of 3 through 50 kva, single phase, 600 v and below, are easy to install because of their smaller size and lighter weight, according to Allis-Chalmers Mfg. Co., manufacturer. Convenient knockout locations permit standard size conduit to be connected from either side or bottom. Impregnated core and coil unit isolated from case assures quiet operation, it is stated. Coils are wound with high temperature epoxy film insulated wire. Shipped assembled, this transformer is suggested for spot load center applications where critical voltage must be maintained.

5—Protective coating for exposed metallic structures

No-Ox-Id "Az" is announced by Dearborn Chemical Co., as a one-application drying-type coating designed for maximum mechanical and chemical protection of structures under severe corrosive conditions. The metallic pigmented coating incorporates a specific vehicle for spray application. It penetrates and loosens slab rust and curled paint, then dries to a firm silvery finish. It can be applied to a painted surface with only limited surface preparation, company says, and dries to a firm finish.

6—Control system starts, loads and shuts down engines

Developed by Fulton Sylphon Div. of Robertshaw-Fulton Controls Co., to meet requirements of gas compressing application, this control system for internal combustion engines, including diesels, is expected to have wide industrial application to automated processes. It incorporates safety functions to signal or shut down engine due to malfunction of an unlimited number of measurable variables. Sequence starting and stopping functions include specific steps as

required by the individual engine installation. Start and stop functions are controlled in sequence and interlocked, company states, and the system is inherently explosion-proof. The building block concept provides maximum versatility and pneumatic circuitry with simplified components affords ease of maintenance. Measured variables are monitored continuously. Variables include temperatures, pressures, liquid levels, vibration and engine speeds. Folder SF-760 gives full information.

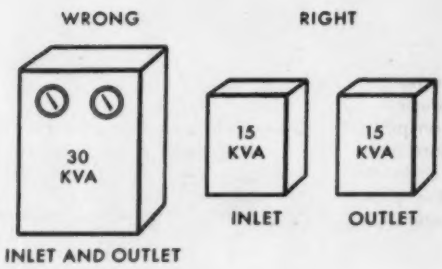
7—Blow-off and drain valves designed for long service

For process steam applications, heating and utility use, these blow-off and drain valves are engineered to last the life of the boiler on which they are installed, according to manufacturer, Manning, Maxwell & Moore, Inc. Long service is attributed to use of corrosion resistant materials and operational advantages of company's Blo-Deflector seat disc. Its operation serves to keep the seating surface of the disc out of the line of flow — in open position, neither seat surface nor disc surface is affected by the flow. Thus, it is pointed out, water velocity can't cut the seating surface. The valves come in both straightway and angle types in 1½-, 2- and 2½-in. sizes. Pressure rating for a 300-lb class is 395 psi at 775 F working steam pressure; for a 600-lb class, 800 psi at 775 F. Bulletin 235 gives details.

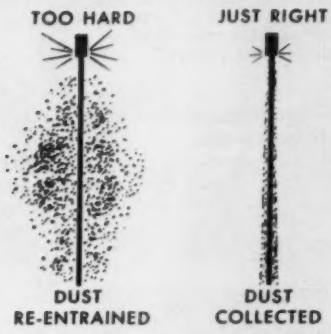
8—Single unit houses complete cascade control set-up

All panel-mounted components needed for pneumatic cascade control of a process are contained in a remote control station announced by The Foxboro Co. Using two Model 58 Consotrol Controllers, this station receives measurements from two points in the process, recording them on the same chart. Output of the primary controller pneumatically adjusts the set point of the secondary controller whose output, in

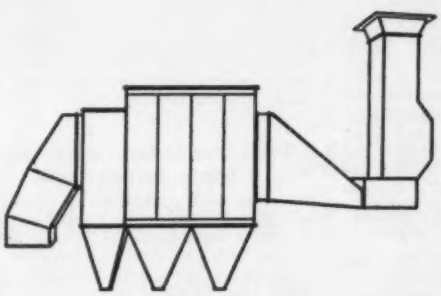
How to Evaluate Cottrell Precipitators



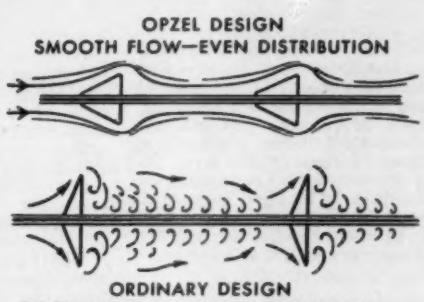
1. Electrical Sets should be arranged and rated to suit best the requirements of a specific job. Since electrical conditions can vary widely at different parts of the precipitator, it is good design to include several electrical sections in series, energized from separate sets so that each section may be energized as needed. Sets should be sized according to the amount of power the precipitator can absorb. A large excess of installed power, which will never be absorbed, means inefficient use of its equipment.



3. Rapping Intensity. Rappers should have easy means to vary the intensity of the blow to suit variations in operating conditions. A pre-set intensity setting cannot possibly give proper rapping over the normal range of operation. If too soft, build-up will occur which will disturb electrical conditions. If too hard, there will be reentrainment. Means of intensity adjustment are necessary to avoid drop-off of precipitator efficiency as conditions change.



2. Gas Distribution. Remember that gas distribution, gas baffling, and provision against hopper sweeping all have a large influence on collection efficiency. The gas flow system should be analyzed as closely as possible, both in the precipitator and in the associated duct-work. If in doubt, have a three-dimensional gas flow study made. Two-dimensional gas flow studies *are not as accurate* and may lead to erroneous conclusions.



4. Baffle Design. Careful attention to the design of baffles on the collecting plates is most important. Small amounts of reentrainment mean tremendous differences in over-all collection efficiencies. It is seen that the "quality" of the collecting surface is far more important than quantity—quantity (sq. ft. of surface or treatment time) in itself is not a criterion of performance.

The point of all this is that so many factors enter into evaluating an electrical precipitator that you should consult with the leading manufacturer—Research-Cottrell

Research-Cottrell, with over 1198 years of combined engineering skill and experience, is the undisputed leader in electrical precipitation.

Research-Cottrell

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, N. J.

Representatives in principal cities of U.S. and Canada

RC 804

TRADE MARK

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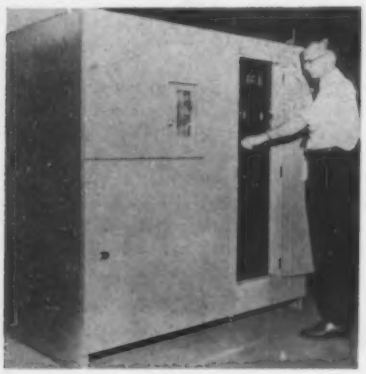
turn, operates the valve. Designed to save panel space, the station occupies only 6-by-6 in. of panel frontage, as compared with 84 sq. in. required by conventional two stations and subpanel. Automatic/manual switching and adjustment of pneumatic-set valves are made at the station where all cascade components, except for a rack-mounted secondary controller, are housed.

9—Compact substations take up less floor space

Ultra-compact, packaged electrical substations which slash overall size and floor space requirements by as much as 53 per cent in size, 40 per cent in floor area are announced by I-T-E Circuit Breaker Co. An expansion of company's



line of Tranfo-Units, these new compact models combine high- and low-voltage control and protection equipment with a dry type power transformer in a single, integrated assembly. They are designed to handle power needs of commercial and industrial plants, schools, hospitals, will be built in quantity lots and virtually off-the-shelf items, available in ratings from 75 through 500 kva. Dimensions are same for all ratings: 75 in. long, 38 in. deep, 70 in. high. Because all leads are front connected, even more space can be saved because the unit can be placed against a wall or in a corner.

10—Wet scrubber is compact and economically priced

High efficiency in handling dust, fume and odors is claimed for the Hydro-Volute Scrubber announced by The Johnson-March Corp. Its cost is reportedly 20 to 40 per cent less than previously available hydro-precipitator scrubbers of same capacity. Efficiencies up to 99 per cent on materials as fine as fly ash are attributed to scrubbing achieved by vortexing the gas flow in a series of chambers, each shaped to produce a swirling action within, so the gas is scrubbed with water and wetted dust particles centrifuged out of stream.

The scrubbers come in capacities from 1000 to 60,000 cfm — the smallest unit is about the size of an office file cabinet. Constant or intermittent removal of sludge can be accomplished manually, hydraulically or mechanically, depending on application. Standard equipment on units to 10,000 cfm includes reservoir, liquid level control, moisture extractor and one or more water-tight access doors. Larger units are similarly equipped except that no reservoir is required where a settling pond is used.

11—Condensing unit comes in low silhouette design

The LSCU is available from Dunham-Bush, Inc., in five basic sizes, 10 through 30 tons, specifically designed for air conditioning applications requiring use of water savers. It is basically a standard low silhouette blower condenser, complete with a Brunner-Metic motor-compressor, Heat-X liquid receiver, electrical controls and refrigeration accessories mounted in a special section for field attachment or remote installation. These units can be located anywhere without regard to prevailing winds, company states. Air movement, up and out, means minimum noise rating and no objectionable air flow toward neighboring buildings. Enclosures are designed for outdoor use and constructed for easy accessibility. Bulletin 7017 gives details.

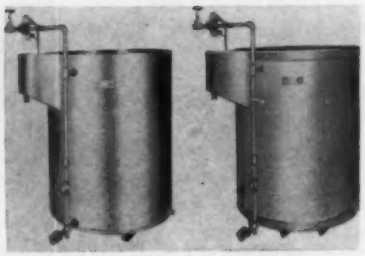
12—Heat exchangers are low-cost, double pipe units

This low-cost, 3-in. double pipe heat exchanger is announced by Brown Fintube Co. as having greatly amplified assembly and disassembly and maintenance features. Tubeside connection and closure require only two ¾-in. alloy steel studs each, which reduces the cost of these exchangers over double pipe units requiring a more complex bolting arrangement. Economies are further obtained by a simplified hammer lug design which locks the head to tube closure into place with one large hammer type nut. The hammer ring is accessible from the front end.

The units are so designed that the tube element can be pulled straight out from the shell. You don't disconnect any tubeside piping — just remove the two studs making up the tubeside joint. Company furnishes both outlet as well as inlet shell and tube flanges for connecting piping. Standard 3-in. low pressure heat exchangers are made with fintubes for design pressures of 5-600 psig. Types for higher pressures are available. Data in Bulletin 110.

13—Pourable cement reduces anchor bolt setting time

Nacor Anchor Bolt Cement, offered by National Asphalt Corp., is furnished in powder form. Mixed with water, it becomes semi-fluid, easy to pour or trowel. Applied around a bolt, it is claimed to bond firmly to both bolt and hole surfaces and set in 10 min. According to manufacturer, anchor bolts in Nacor cement can be drawn tight and ordinary stationary equipment put in operation within 30 min. Company recommends material for fastening of partitions, pipe flanges, hand rails, seats, guide posts, etc. It can also be used for emergency repair of shallow holes in concrete floors.



14—Brinemakers in stainless steel and plastic models

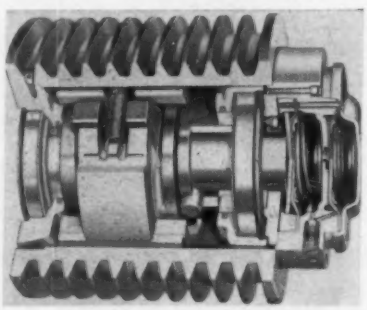
The Morton Salt Co. has introduced two new brinemakers. Model E-S is made of extra heavy, low carbon stainless steel to offer durability, permanency and cleanliness. All fittings are of stainless steel or brine inert plastic. Model E-P is an all plastic unit. This lightweight model is translucent and permits observation of salt supply and liquid level through tank wall.

15—Pneumatic control stations for automatic-manual systems

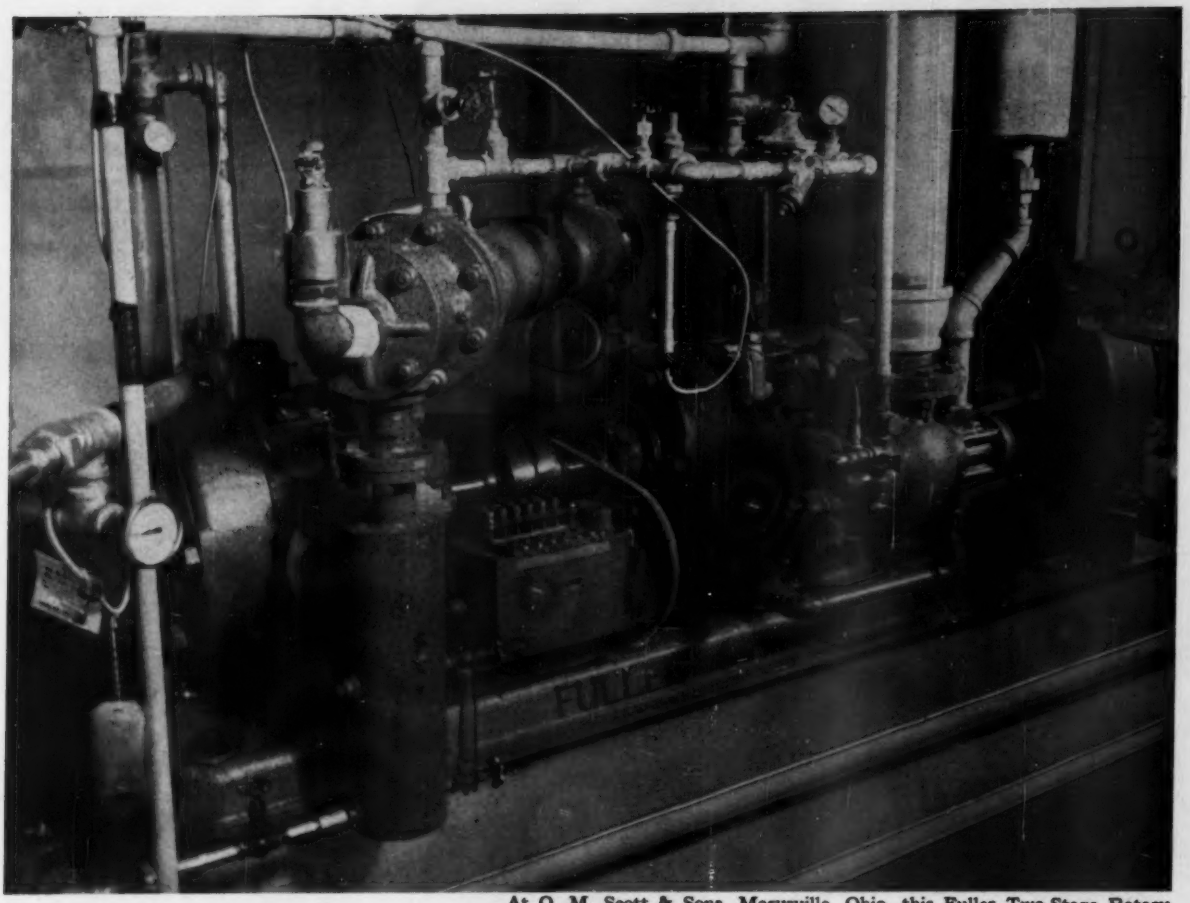
This line of pneumatic control stations, for bumpless transfer between automatic and manual operation as well as for set point loading and manual loading, is introduced by Republic Flow Meters Co., and designed to operate with company's Vector series of instruments and controls. Control stations are claimed accurate within 1 per cent of full scale. Controlled variable is indicated on automatic and manual operation. Control stations have input and output ranges of 3-15 psig, with air consumption of less than 0.2 scfm. Red outer pointer indicates manual loading pressure and black center pointer indicates automatic loading pressure.

16—Transmission accessory is triple purpose unit

Serving three purposes in electric or gasoline engine drives, Power-Max combines an automatic clutch, adjustable torque selector and variable starting time delay. Produced by Olme Precision, Inc., in sizes from 3 to 2000 hp, the drive unit is said to eliminate need



for over-size and special type motors while protecting the power unit and driven mechanism. Power-Max is described as a centrifugally-operated clutch adjustable both for maximum torque transmitted and time delay in picking-up the driven load. A feature pointed out by manufacturer is that, with Power-Max, "starting load" is eliminated, even in applications normally having exceptional starting loads



At O. M. Scott & Sons, Marysville, Ohio, this Fuller Two-Stage Rotary Compressor with overhead intercooler and 60 hp motor has operated 24 hours a day straight through for one year, without downtime or maintenance.

No Air Starvation with a Fuller Compressor in the Packhouse

Maintenance Supervisor Alfred Asman of O. M. Scott & Sons, Marysville, Ohio, has high praise for their Fuller compressor: "Before we had the Fuller, we regularly had complaints of low air pressure. Since the Fuller is supplying all the packhouse air requirements, no one has complained of lack of air."

Their Fuller Rotary Two-Stage Compressor unit with overhead intercooler, producing 281 cfm, 100 lb. gage discharge pressure, has operated 24 hours a day straight through for one year—without even a sign of blade or bearing wear.

Reliable performance and dependable delivery of air, when and where needed, is only part of the story. Scott & Sons, along with others using Fuller Rotary Compressors, know that only minor maintenance of parts is all that is necessary for years to come—creating savings in labor, downtime and materials.

The key is Fuller's rotary principle which permits a design completely free of reciprocating parts. Elimination of valves, crankshafts, pistons and other moving parts cuts the need for attention, adjustment and replacement. Blades are "held" to cylinder wall by centrifugal force—automatically compensating for wear—thus maintaining new machine efficiency.

What's more, compact, easily installed Fuller Rotary Compressors are vibration-free, further reducing costs by eliminating the need for involved and expensive foundations.

A Fuller specialist will gladly discuss your compressor needs and suggest a system geared exactly to your specific situation. Write for Bulletin C5-A today or contact Fuller on your plant requirements.

2561
C360

FULLER COMPANY GENERAL AMERICAN TRADE MARK

FULLER COMPANY
150 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

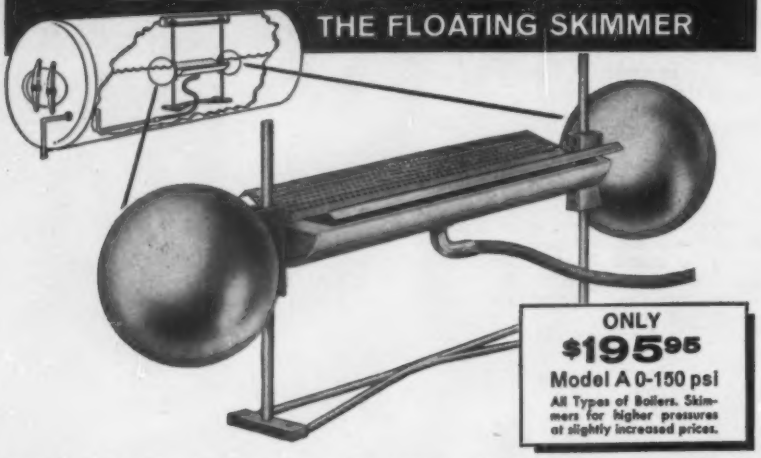
Fuller
....pioneers in harnessing AIR

For more data circle 558 on Post Card

Boiler down-time cut 60% with

SURFBLOW

THE FLOATING SKIMMER



Tests and user reports prove SurfBlow Floating Skimmers cut down-time up to 60%—reduce blow-off over 50% for internally treated boilers—cut water treatment over 45% in many installations!

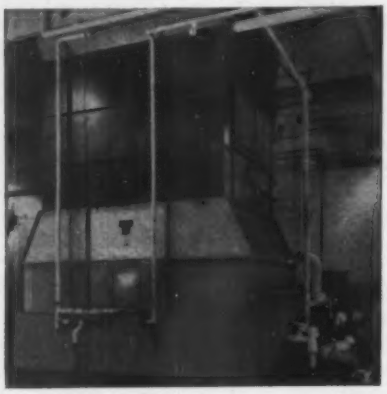
SurfBlow automatically skims off boiler water impurities from the critical steam release zone, whatever the turbulence or water level fluctuation. Simple to install. Made of maintenance-free stainless steel. Pays for itself in weeks—even days! Write now for complete information.

BOILER SPECIALTIES CORPORATION

88 Box 485, Gary, Indiana

For more data circle 559 on Post Card

WHEREVER YOU NEED TO COOL A FLUID... and have a problem of water supply or disposal... use NIAGARA "AERO" HEAT EXCHANGER



▶ Evaporating a very small amount of water in an air stream you can cool liquids, gases or vapors with atmospheric air, removing heat at the rate of input, controlling temperature precisely. Save 95% of the cost of cooling water; save piping, pumping and power. You quickly recover your equipment cost.

You can cool and hold accurately the temperature of all fluids, condense vapors, cool water, oils, solutions, intermediates, coolants for mechanical, electrical or thermal processes. You have a closed system free from dirt. You have solved all problems of water availability, quality or disposal, maintenance expense is low.

You may apply this to solvent recovery, vacuum systems controlling reactions, condensing distillates, cooling reflux products.

For more information, write for Bulletins 120, 124, 135. Address Dept. E-8

NIAGARA BLOWER COMPANY

Dept. E-8, 405 Lexington Ave., New York 17, N. Y.

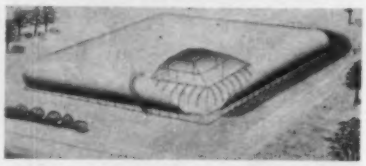
Niagara District Engineers in Principal Cities of U. S. and Canada

For more data circle 560 on Post Card

—power requirements never exceed those of normal running load. Power-Max is said to give smooth starts and gradual acceleration, absorbing shocks. If an overload occurs in the driven mechanism, the unit "soaks up" the overload. Bulletin 260AD gives details.

17—Ground level water tank holds more, costs less

Developed by Graver Tank & Mfg. Co., the Cylindroid is a ground-level, high-capacity reservoir designed to fill the need for a low-cost unit which can be built to any capacity to serve present and future requirements. According to manufacturer, this tank provides approximately 16 per cent more storage



capacity than a comparable cylindrical type. It costs less to build because lighter steel can be used, a minimum of shop fabrication is required, and erection is simplified. It can be erected on the site with a small crew and light equipment, it is pointed out; fit up is all straight-line and welding is all down-grade. And because of its low height, the Cylindroid can be screened with trees and other landscaping.

18—Oil burner for use with No. 4 and No. 5 fuel oils

Designed for reliable and economical heating in small and medium sized commercial buildings, and for firing hot water generators or steam boilers, the C-45 Oil Burner of National Airoil Burner Co. has a capacity range of 10 to 33 gph under natural or induced draft, and 15 to 30 gph when firing pressurized furnaces. Simplicity is a major feature announced. The burner is shipped as a unit and no auxiliary equipment is required where fuel tank is indoors or buried nearby. Where tank is at some distance, a small auxiliary pump unit is available. The C-45 is suggested for both new plants and for replacing old installations of rotary and other types of burners, and as a replacement for light oil burners in the 15-33 gph range. It can be installed to use the light oil available and the change to heavier oil made in the future.

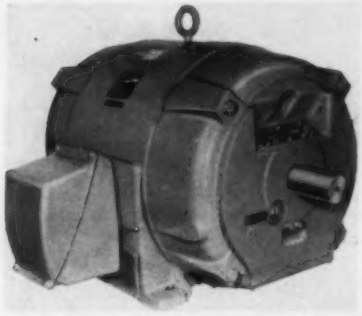
19—Dust control system designed for small plants

The Type G Chem-Jet Proportioner is announced as a simpler and more compact dust control unit, offering worthwhile savings for limited capacity plants. A product of The Johnson-March Corp., it is reported of particular significance to industrial power plants receiving 150 tons of coal per day or with coal handling capacities not exceeding 100 tph and small crushing plants where handling capacities do not exceed 150 tph. Dust is controlled by applying a small amount of moisture at points in the operation where dust is created. To produce the wetting action, a surface active compound is used. This concentrated solution is mixed by the system with water in a ratio of one part solution (company's Compound MR-200) to 200 parts

of water. The low cost system includes a proportioning pump to deliver a fixed quantity of the compound from a solution drum, spray jets with housing and strainer assemblies, a ¾-in solenoid valve, strainer and plug valve, and push button control. The unit must be supplied with clean water at 60 psi pressure at points of application.

20—Motors, 40 to 250 hp, in three basic NEMA designs

Designed as auxiliary units for generating stations, this new line of powerhouse Life-Line A motors is introduced by Westinghouse Electric Corp. for a wide range of applications. Designs A and B



(normal torque) are for pumps, compressors, fans and blowers. Design C (high breakaway torque) is for driving compressors without unloaders, loaded conveyors, certain coal pulverizers, Design D (for high accelerating duty or high inertia loads) is for car dumpers, coal trippers, hoists etc. Among features are end brackets designed to provide maximum dripproof protection for these squirrel cage units.

21—Non-toxic water treatment for use in cooling systems

Dearborn 860, a non-toxic corrosion inhibitor, is announced by Dearborn Chemical Co., for open recirculating and once-through cooling systems where toxic contaminants (chromate) are not permitted. Treated blow-down water from cooling towers or spray ponds can be discharged into streams, without endangering fish or animal life, it is stated. According to manufacturer, Dearborn 860 provides corrosion protection comparable to chromate-polyphosphate combinations, and superior to many polyphosphates. It forms a protective film faster to provide rapid control of pitting and corrosion. In open recirculating systems, the organic constituent of this white powder provides extra insurance against carbonate and phosphate deposits, company points out — and will interfere with crystal growth, even under severe scaling tendencies of water. It has a density of 12 lb per gallon, is slightly hygroscopic.

22—Double seat valves for drawing water from tanks

These valves designed by the Jennings & Johnston Co. to permit drawing water from the bottom of storage tanks, have two seats or valves mounted on the same stem. The inner valve seats first. This permits chamber between inner and outer valve to drain before the outer

NEW Pratt CYCLONE STRAINER

Eliminates Manual Cleaning
Costs Less to Install

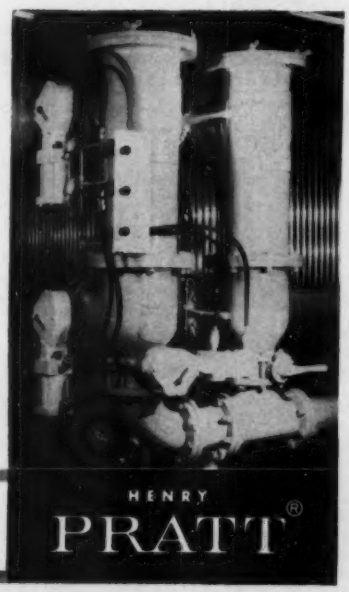
The new Pratt Cyclone Strainer eliminates the manual cleaning usually associated with this type of equipment. Both cleaning and backwashing operations are completely automatic and can be accomplished in seconds.

Unique design simplifies piping, saves space and installs for far less than ordinary designs.

Patented "Cyclone" action keeps larger particles away from basket—keeps strainer "on the line" longer.

Features rubber seat butterfly valves for longer life and positive action. Manual or automatic valve operators.

Write for details.



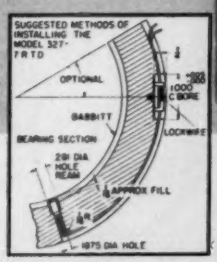
HENRY PRATT COMPANY
319 W. Van Buren St., Chicago 7, Ill.
Representatives in Principal Cities

For more data circle 561 on Post Card

EDISON

MINIATURE RTD 327-7 MEASURES PRECISE TEMPERATURES from −70° to +450°F

(3 times actual size)



This miniature tip-sensitive Resistance Temperature Detector has its sensing element located within .060" of tip for fast response to temperature changes. Small size enables it to be installed where larger types of temperature sensing elements would not fit. It may be mounted from inside of bearing and its tip is tinned so that it may easily be covered with babbitt after installation. Use with terminal 41820. For complete information, write for Reference Data Sheet 1045A-9.

SPECIFICATIONS:

Temperature Resistance Characteristic: No. 7
Time Constant in Water: 4.0 sec.
Maximum Current in Bearing: 0.015 amps
Maximum Pressure: 2500 psi in babbitt installation

THOMAS A.
EDISON INDUSTRIES
INSTRUMENT DIVISION
West Orange, New Jersey

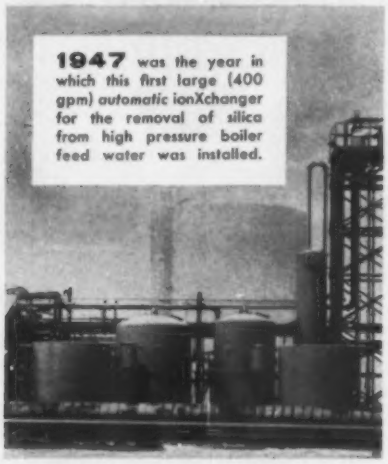
McGRAW EDISON

For more data circle 562 on Post Card

PATHWAYS OF A PIONEER

ILLCO-WAY DESIGNERS AND BUILDERS

MODERN EQUIPMENT FOR ionXchange


1947 was the year in which this first large (400 gpm) automatic ionXchanger for the removal of silica from high pressure boiler feed water was installed.

Blazing the Way for De-I Developments

Again we bring you an example of how IWT has always been in the forefront of the development of practical and successful ion-exchange equipment. The big boiler-water de-ionizer shown above is now more than 12 years old, is still in operation, and has been joined by two more IWT units of similar size in this sprawling midwestern chemical plant. Many other early users of ILLCO-WAY ionXchange have since *added to* and *modernized* their installations as new developments became available.

The pioneering work which IWT started in 1937, with the advent of the first commercial ionXchange resins, is still being carried on — for the benefit of present users of IWT equipment, as well as future customers. New ideas, new processes, new resins, new methods of construction, new materials, new parts and accessories — all these are under constant consideration from the foundation of long experience and with the zeal of the forward look.

THIS EXPERIENCE CAN MEAN A LOT TO YOU

If you need pure water for high-pressure boiler make-up or process use, or if you are considering the use of ion-exchange for purification or concentration of chemical products, be sure to take advantage of IWT pioneering experience and specialized knowledge. *Call your IWT representative.*

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

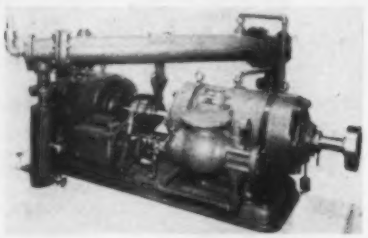
For more data circle 563 on Post Card

one is closed. Company points out that since inner valve is well inside the tank, insulated by the air chamber between it and the outer valve, and surrounded by tank products, the valves are non-freezing under normal conditions. This is claimed to be the only valve that lets the operator push on the handle with the inner valve closed, and the outer one open, to flush any foreign particles that might cause leakage off the seat of the inner valve.

The cap on the end of the valve body, and the outer valve can be removed, and the seat on the outer valve replaced while the inner valve remains closed, it is stated, to permit servicing without emptying the tank. The unit comes in four sizes, designed for threaded or flanged tank mounting.

23—Two-stage compressors are compact and pre-assembled

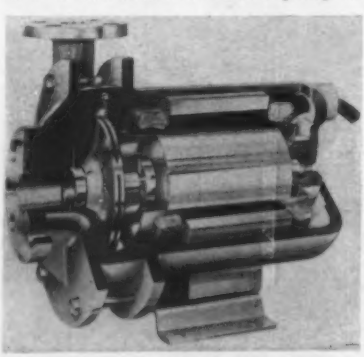
Designed by Fuller Co., to simplify installation and foundation problems these rotary compressors come preassembled — addition of motor, air and water piping is all that's required. They



feature an overhead intercooler for compactness, and can be placed for operation on a floor or mezzanine. The line includes two-stage models covering capacities from 279 to 3300 cfm and discharge pressures to 125 psi. Direct connection can be made to electric motors, gas motors, or gear-turbine drive. Each stage comprises a cylinder with heads, thoroughly water-jacketed. Intake and discharge openings are in a horizontal plane on opposite sides of the cylinder, to avoid reversal of air flow and further simplify piping.

24—Canned pumps handle hazardous or costly fluids

This canned pump is designed for leak-proof handling of dangerous or expensive fluids. Manufactured by The Moyno Pump Div., Robbins & Myers, Inc., it is a self-contained motor pump in



which material being handled circulates within motor. The pump impeller is

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POWER PLANT SHIFT SUPERVISORS

For a utility within 100 miles of Philadelphia consisting of a new high pressure 33,000 KW steam power plant, an existing 8,500 KW steam power plant, and a distribution system covering 88 square miles. Minimum 5 years' experience. Good working conditions. All applications will be acknowledged.

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It Pays

The easiest — and quickest — way to order bulletins and catalogs described in this magazine is to use the postage-free Reader Service Cards on pages 119–120.

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PALMER

Mercury Actuated Dial Thermometers now in three types to suit any requirements

PATENTED
FULL 4½" DIAL FACE. Stem can be placed at any angle and case can be rotated to any readable position.
1 RIGID STEM DIAL THERMOMETER tapered bulb, interchangeable with standard industrial thermometer separable socket. (As illustrated above.)
2 WALL MOUNTED DIAL THERMOMETER with flexible connecting armor. Case adjustable to easy reading position.
3 FLUSH MOUNTED DIAL THERMOMETER for panel mounting with flexible connecting armor.
ALL THREE TYPES HAVE A FULL 4½" DIAL FACE.

■ **for accuracy:** Mercury actuated . . . Compensated by Invar. Guaranteed Accurate 1 scale division. ■ **for angularity:** Can be adjusted to most readable position at any angle desired. ■ **for readability:** Bold Black Numbers . . . 11" of scale Reading Dial face can always be placed in easiest readable position. ■ **for interchangeability:** Also specify "PALMER" Separable sockets as they are interchangeable for Dial or Industrial type Thermometers.

PALMER

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Norwood Ave., Cincinnati 12, Ohio
MFRS. OF INDUSTRIAL LABORATORY, RECORDING AND DIAL THERMOMETERS

For more data circle 564 on Post Card

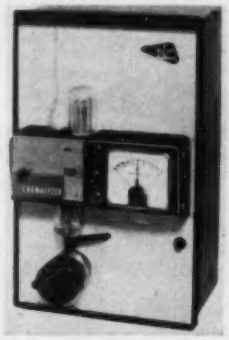
connected directly to the motor shaft — no seals, packing or stuffing box are required. The motor rotor and field are encased in welded stainless steel "cans," isolated from material being pumped. The pumped fluid lubricates the unit. All wettable parts of the pump, except the Graphitar bearings, are made of 316 stainless steel. The pump is designed for all-angle installation, suited for use in close quarters, and available in ½-, ¾- and 1-hp ratings, with capacities ranging to 63 gpm.

25—Adjustable pulse switch for industrial application

This pulse-producing snap-action switch (Catalog 1 PD1) is offered by Micro-Switch Div., Minneapolis-Honeywell Regulator Co., for use where momentary opening and/or closing of a circuit is necessary, and for controlling pneumatic valves where permanent-duty solenoids are not used. The entire pulse operation occurs as the plunger is depressed; no switching action takes place on the return stroke. Mechanical characteristics include 0.600-in. minimum total plunger travel, 4-lb operating force and 8-lb full overtravel force. Pulse length is adjustable from 0.030 to 0.450 in.; the adjustable plunger can be extended 0.750 in. The switch is sealed against oil, water, dust and dirt. Electrical characteristics of the single-pole double-throw switch are 10 amp at 125, 250 or 480 v a-c; ½ amp at 125 v d-c; and ¼ amp at 250 v d-c.

26—Colorimetric analyzer with photoelectric comparator

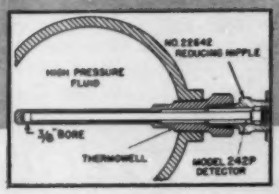
The Chemalyzer, announced by Milton Roy Co., is designed to make possible automatic, on-stream monitoring of hardness, residual chlorine or phosphates, 24 hr a day. Standard ranges of accuracy are given as: hardness, 0-3 ppm; residual chlorine, 0-1 ppm; residual



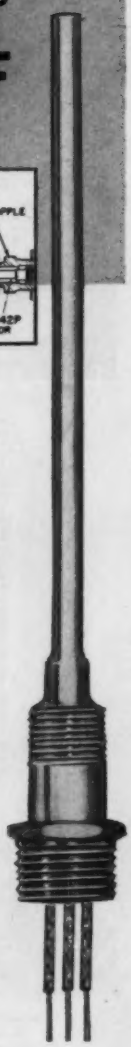
phosphates, 0-30 ppm. In addition to a photoelectric comparator, the Chemalyzer contains an indexing motor which proportions a 0-7 cc reagent feed with a fixed sample volume at variable intervals, and an indicator with an alarm contact adjustable over the full span of standard ranges.

Costing less than $1,000, the Chemalyzer is reported to monitor: zeolite or base exchange softeners by determining hardness breakthrough, sounding an alarm or automatically initiating regeneration cycle; residual chlorine in potable water and cooling towers, warning of high or low limits; excess phosphates residual in boiler water, starting a controlled volume pump for phosphate feed when residual is below a fixed

EDISON
RTD 242P MEASURES FLUID AND GAS TEMPERATURES from −100° to +1500°F



This stem-sensitive Resistance Temperature Detector can be operated in live steam and other high temperature atmospheres up to 1500°F. Widely used in the chemical and petroleum industries, the stainless steel 242P RTD provides readings to 0.01°F. For complete information, write for Reference Data Sheet 1045A-5.



SPECIFICATIONS:

Temperature Resistance Characteristic: No. 8
Time Constant in Agitated Water: 10 sec. approx.
Maximum Current in Air: 0.010 amps; in Water: 0.020 amps
Maximum Hydrostatic Pressure: 300 psi at 1380°F.

THOMAS A. EDISON INDUSTRIES
INSTRUMENT DIVISION
West Orange, New Jersey
McGRAW EDISON

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Portable Pyrometer Indicator Does Many Jobs

MINIMITE®

Null Balance, Potentiometer Type

The "MiniMite" Portable Potentiometer Indicator gives you laboratory accuracy in a rugged, versatile instrument. Use it conveniently for a wide range of temperature measurement, calibration and test purposes. Its dimensions are only 4" x 5" x 6"—weight is under 4 lbs. Accuracy is ¼ of 1% of scale range.

Temperature Measurement For direct temperature measurement, connect the "MiniMite" to a thermocouple. It's ideal for laboratory work, emergency operation or substitution for instruments under repair...also for many types of research and test work.

Calibration Use the "MiniMite" with equal facility for calibrating thermocouples, or both potentiometer and millivoltmeter-type instruments.

Scale Range Individual ranges on the "MiniMite's" double-range scale are almost 24" long. Choose from 49 different range combinations to cover temperatures from −300°F. to +3200°F. for all standard thermocouples, and millivolts from −6.2 to +62.

Write for Bulletin 64-21

Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY

In Canada:
THERMO ELECTRIC (Canada) LTD.,
Brampton, Ont.

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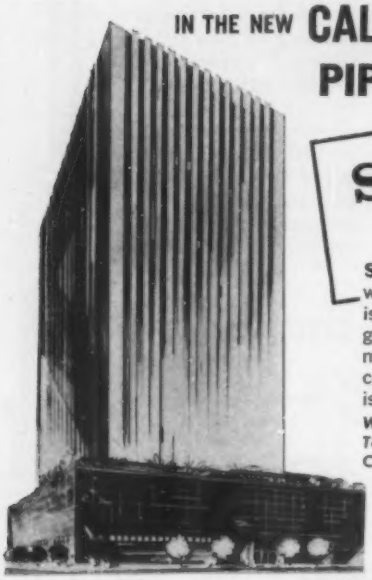

PIPING SYSTEMS ARE SAFE and SILENT!

Silent Check Valves operate instantly when flow reversal starts or when flow is zero. In this handsome new Los Angeles structure, as in hundreds of other major buildings — surge pressures are controlled, troublesome water hammer is eliminated.

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Our 74th Year • 1886-1960

Williams-Hager **Silent CHECK VALVES**

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concentration; other one-reagent colorimetric analyses. Bulletin 858-1 gives detailed information.

27—Severe-service angle valve with quick-change trim

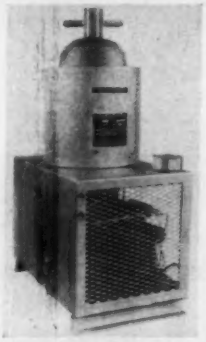
Quick-change trim can be replaced in minutes without opening line piping in the V-10, a low-noise throttling valve for high-pressure liquid and steam announced by Republic Flow Meters Co. Valve plug, guide and seat can be replaced in little more time than required to open and close a bolted joint, it is pointed out. The valve is designed for severe service, where pressure drops may be as high as 3500 lb or where flashing may occur. It is angle style, diaphragm-operated and available in 1500-, 2500- and 4500-lb classes, from 1½- through 4-in. sizes. The quick-change trim is available in the 1500- and 2500-lb classes. Product Specification Sheet 704.21 gives full details.

28—Annunciator lamp cabinets with large size windows

Type GRE is announced by H. R. Kirkland Co. as a 100 section cabinet offering large size — 3½ in. square — backlighted windows which can carry engraved messages or hand marked legends applied with grease pencil. Units can also have larger or smaller windows which can be grouped as desired in flush or surface type cabinets. Lamp sockets are wired to a common terminal block, offered for 24-, 115- or 220-v service. Units are also available with individual push buttons and/or with toggle switches.

29—Refrigerated air dryer is medium capacity unit

Model F-100 is designed to cool compressed air to 40°F at pressure, to relieve the air of its moisture and oil vapor content. A product of Hankinson Corp., it employs the principle of Freon-circulated closed-loop refrigeration to accomplish its compressed 'air drying'—no prefilters or aftercoolers are necessary. This medium capacity unit is rated at 30 scfm at 100 psig, 100 F inlet



air temperature, and 75 F ambient temperature. When compressed air is dehydrated at this elevated pressure and then reduced for instrument service, atmospheric dew points of −5 F are possible, company states. The unit itself combines a ½-hp refrigerating section, condenser-evaporator-type heat exchanger, replaceable filter element, and automatic discharge mechanism in an insulated ASME coded pressure vessel.

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A DIVISION OF SEISMOGRAPH SERVICE CORPORATION
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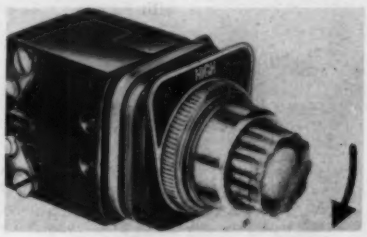
For more data circle 568 on Post Card

A feature noted is continuous service without need for cycling or on-off service, made possible by a hot-gas by-pass arrangement which regulates amount of Freon introduced into the condenser-evaporator and permits low dew points to be maintained despite load or temperature variance. The unit operates on 115 v, 60 cycle, single phase electrical current. Operating costs are said to run under 25 cents a day.

30—Lighted push button with "turn to test" feature

This lighted oil tight push button announced by The Arrow-Hart & Hegeman Electric Co. offers advantages of a push-to-test pilot light and lighted push button in one space-saving unit. It also provides an instant test to determine if the lamp is burned out. Before pushing the button to start the motor or other equipment, you give the button a half turn. This energizes the lamp circuit without affecting the control circuit and shows whether or not the lamp



lights. A similar test can be applied if pilot should go out after motor has been started. As manufacturer points out, this affords safety and convenience benefits especially where equipment is located at a distance from control point. Six color caps are available.

31—Plastic material repairs floor cracks and joints

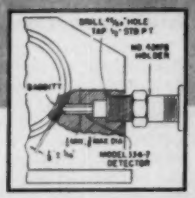
The Monroe Co., Inc. introduces a plastic material called Jiffy Floor for filling cracks, expansion joints or shallow holes in concrete or plank floors. The

material contains no asphalt, gravel or concrete, company says, and is ready to use indoors or out because it is not affected by temperature changes. Illustrated are the four quick steps for using Jiffy Floor — clean crack or expansion joint, prime, fill and compact.

32—Reducing and relief valve for initial pressures to 4000 psi

The 3850 Type F is announced by Atlas Valve Co. as a pressure reducing and relief valve for water, oil, air and gas service to initial pressures of 4000 psi. Available in ⅛- and ¼-in. sizes, the valve is used to control small units under test or to supply a process or

EDISON
RTD 334-7 MEASURES BEARING TEMPERATURES IN EXPLOSIVE ATMOSPHERES from –70° to +500°F



This tip-sensitive general purpose Resistance Temperature Detector is designed to measure such metal temperatures as machinery bearings. Responds to temperature changes at its tip only and is unaffected by temperatures around tubing. Used with holder 42078, this hermetically sealed RTD is suitable for application in hazardous areas defined by...National Electrical Code as Class I, Groups C and D, Class II, Groups E, F and G, and Class III. For complete information, write for Reference Data Sheet 1045A-11.

SPECIFICATIONS:

Temperature Resistance Characteristic: No. 7
Time Constant in Agitated Water: 2 sec.
Maximum Current in Air: .015 amps; in Water: .025 amps.
Maximum Pressure: 200 psi

THOMAS A. EDISON INDUSTRIES
INSTRUMENT DIVISION
West Orange, New Jersey
McGRAW EDISON

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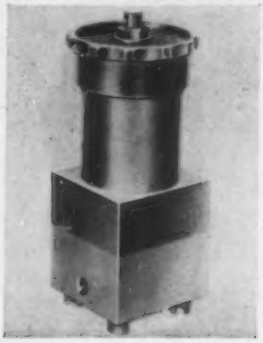
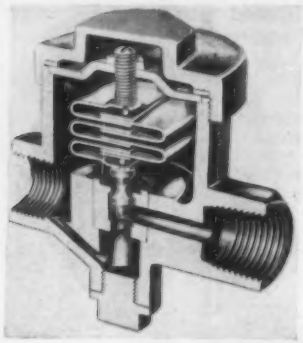
piece of equipment requiring small capacity. Adjustable pressure ranges are 0-1000, 0-2000 and 0-3500 psi and



pressures can be controlled within 2-3 psi over entire adjustable pressure range. Single-seated, spring-loaded, diaphragm-actuated valve is described as simple in design, containing neither external actuating connections nor stuffing boxes.

33—Economical steam trap in high and low pressure types

Pressure-balanced thermostatic and float-thermostatic designs are available in this line of low cost traps, introduced by MIL Div., Farris Engineering Corp. They are claimed unaffected by pressure, water hammer, frost corrosion or rough handling. Operation is maintained by a stainless steel, bi-metal thermal element with universal joints. Resistance to corrosion and metal fatigue is attributed to use of forged aluminum-bronze for the bodies and stainless steel for working parts. The traps are suggested for a wide range of applications including superheat service to 500 F. Among uses are heat exchangers, instantaneous heaters, stills, steam radiators, sterilizers, tanks (coil heated), vulcanizing presses, relay points, terminal ends and branch mains. Pressure ranges



for float-thermostatic types are 0 to 75 psi and 0 to 150 psi; those for the thermostatic traps range from vacuum to 25 psi to 0 to 300 psi. Catalog FE-310 gives more detailed information.

34—Chain wrenches give action grip in tight places

Two rugged chain wrenches — No. C-14 and C-18 — are introduced by The Ridge Tool Co. for work in extra tight quarters. They are designed for fast, ratchet-like action in either direction — from either side. Chain gives tight

grip without crushing, company says, on round, square or irregular shapes. The C-14 handles up to 2-in. pipe and fittings, the C-18 up to 2½ in.

35—Diesel fuel offers improved performance

Premier Diesel Fuel is introduced by Standard Oil Co. (Ind.) to replace Stanolind and Stanolex brands of diesel fuels. According to announcement, this fuel, specifically intended for diesel use, is so made that it cuts wear of injectors, burns better, reduces costly repairs and gives maximum power with minimum engine deposits, smoke and odor. It is colored red to distinguish it from distillate heating oils.

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Let Harco take your corrosion cares away with H.C.P. . . . a scientific approach to electrolytic corrosion in buried and submerged structures . . . *that actually pays for itself!* Competent Harco engineers conduct field surveys, analyze your cathodic protection needs, design complete systems. Harco also provides you with a single source for all your requirements . . . supplies materials, installation, inspection and maintenance services, as desired. Write us today about your specific corrosion problems.

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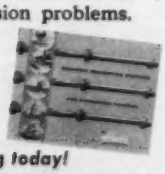

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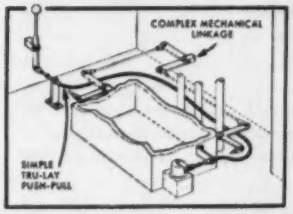
TRU-LAY PUSH-PULL DATA FILE SHOWS HOW TO SIMPLIFY AND IMPROVE DESIGN



Push-Pull remote controls, shown here, are flexible, have but one moving part, and give a lifetime of accuracy. Mechanical linkages are complex, are made of many parts, wear at many points, and produce increased backlash, lost accuracy, and vibration rattles.

This Push-Pull Data File—containing 7 engineering bulletins—will show you how these flexible controls have eliminated mechanical linkages on hundreds of products. You can make *your* products more useful, easier to sell, with Push-Pull controls. Write for your Data File today.

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. . . so it's no wonder that a Leffel Scotch Boiler will outwork and outlast any other

A Leffel Scotch boiler will stand up better and last longer . . . far longer . . . for the simple reason that it's designed and built to do a job, not just to meet minimum code requirements.

Leffel refuses to jeopardize the recognized superiority of the Leffel boiler in efficiency or reliability in order to cut an inch here or a pound there . . . or to save a dollar on production costs.

Instead, Leffel builds a bigger, heavier, stronger boiler . . . with more heating surface for greater efficiency . . . with heavier materials throughout for longer life. Compare the specifications on a Leffel boiler with those of any other boiler on the market today. You'll immediately see why — dollar for dollar and horsepower for horsepower — a Leffel boiler gives you more years of trouble-free, maintenance-free operation . . . more steam per fuel dollar . . . and with a greater margin of safety.

Leffel boilers and boiler-burner units are available to meet all steam requirements from 6 to 500 h.p. Any Leffel boiler can be supplied with factory-installed oil, gas or dual-fuel burner or can, if you prefer, be supplied without burner. If coal is your choice of fuels, your Leffel boiler can be shipped complete with a Leffel underfeed stoker designed specifically for use with Leffel boilers or can be equipped for hand firing.

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THE LONERGAN LINE

HOW TO MAKE A GOOD IDEA BETTER

by Norman J. Smith

In this hurry-up age of missiles and electronics, it is often possible to overlook the fact that because a device or an idea is new, it is not necessarily the best.

For example, while there are many temperature and pressure sensing devices, none

has such universal application as the Bourdon tube, which was first conceived in 1849 by a French engineer, Eugene Bourdon.

Today, a modern "C" type Bourdon tube gauge, such as the Lonergan Maximon makes full use of Bourdon's original idea. At the same time, it utilizes the finest materials such as K Monel stainless steel, beryllium, copper and many, many others in order to improve Bourdon's basic invention. Other improvements are: twisted spiral tubes to measure the output of pressure transducers; long helical tubes with heavy walls to measure pressures up to 100,000 psi; and small tightly coiled tubes for movementless gauges.

While the power plant man with a gauge problem isn't concerned with all of these forms, it is interesting to note that in his application for a patent more than a hundred years ago, Bourdon anticipated all of these present day variations. He claimed application on all forms of curved or twisted tubes whose transverse sections differed from circular forms for temperature and pressure measuring, indicating and controlling of fluids.

The Lonergan gauge today incorporates all of the known advances in the Bourdon tube in any one of three lines. For applications requiring the finest gauge available anywhere, the Lonergan Maximon is the choice.

Get a full description of the complete line of Lonergan gauges in catalog 1000-G. Write for your copy today.

Norman J. Smith

Chief Engineer, Instrument Division

Lonergan

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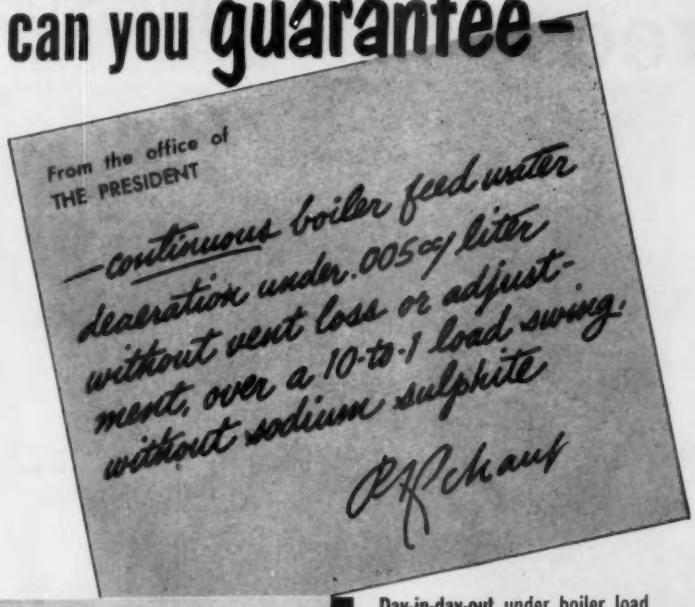
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THE PRESIDENT
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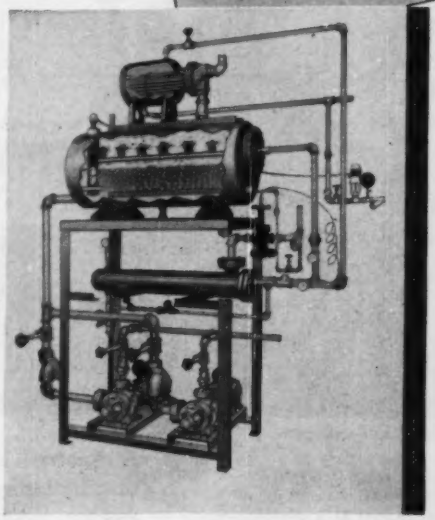
R F Schaub



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Excellent thermal efficiency (insignificant steam vent loss) under **all** regular operating conditions – with no vent adjustment for any load change.

No need for sodium sulphite or other additives. (If you need 'em, you just aren't getting full mechanical deaeration).

Plus at least 6 other savings in operations, maintenance and installation.

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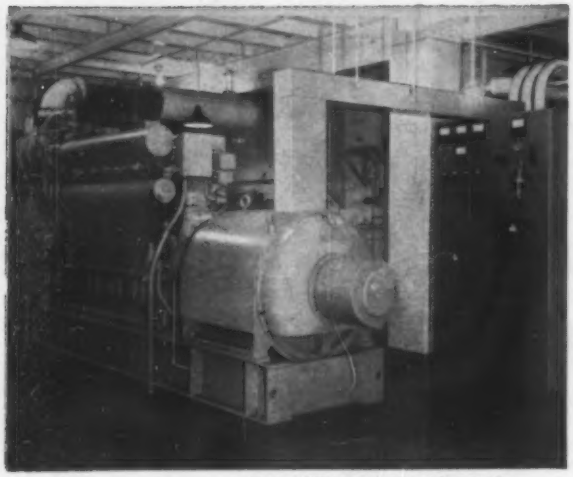

Typical high speed unit with control.

*IDEAL high-speed generators and control equipment pictured above are typical of installations in hundreds of America's leading industrial plants, public utilities and commercial buildings. Custom-designed for longer life with proven efficiency and economy, IDEAL equipment is backed by over a half-century of creative electrical engineering and careful, conscientious workmanship. Unified responsibility for generating units and controls assures you of *better* products *better built* for dependable service with lower operating and maintenance costs. Why not check with IDEAL on your next power application problem?

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The IDEAL ELECTRIC & MANUFACTURING CO.
340 East First St. Mansfield, Ohio

SINCE 1903, AMERICA'S FINEST MOTORS, GENERATORS, MOTOR-GENERATOR SETS, SWITCHGEAR AND CONTROLS

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another outstanding design development from

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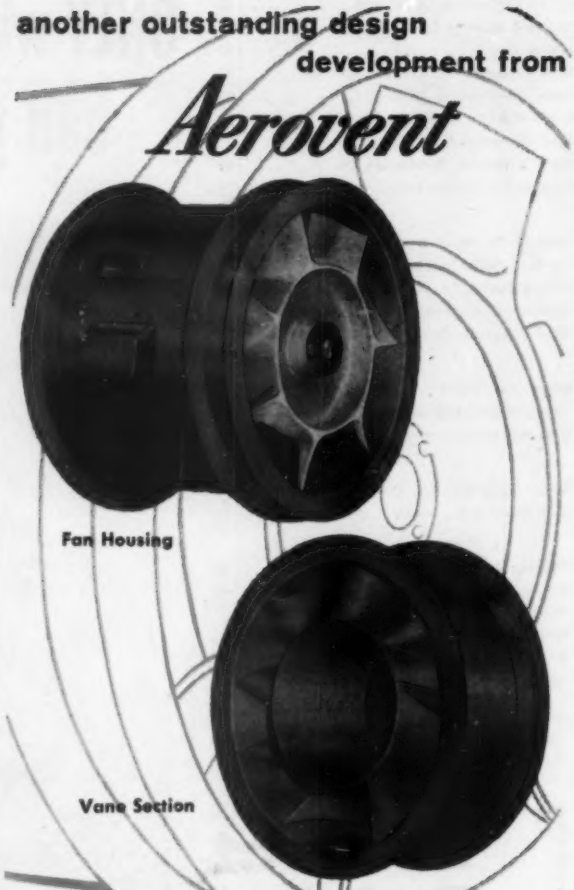

direct-connected vaneaxial fans

with removable vane sections

Engineered for high-pressure, high-velocity air distribution systems, these units feature a unique removable vane section which simplifies installation and permits easy access for routine cleaning and maintenance.

Available in 30 models in sizes 18" to 48" for capacities from 3230 to 67,300 cfm with special design features for all application requirements.

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Air deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance.

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ASH AND BRUSH STREETS PIQUA, OHIO

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It's Precisioneered*

An Island Creek technician uses the optical pyrometer to determine ash fusion point of a coal

* PRECISIONEERING at Island Creek is many things. Essentially, it is starting with superior seams of eastern coal . . . and preparing it to the exact specifications your burning equipment requires to produce steam at the lowest net cost per 1000 lbs. This involves the use of precision engineering techniques in the most modern preparation plants. It involves strictest laboratory controls. It involves far-reaching engineering service and evaluation studies. From start to finish it involves the career company attitude that has made Island Creek a leader to whom other leaders may look—with confidence. We'd welcome a chance to get down to net costs—with you and your plant people. Write. Or phone. No obligation, of course.

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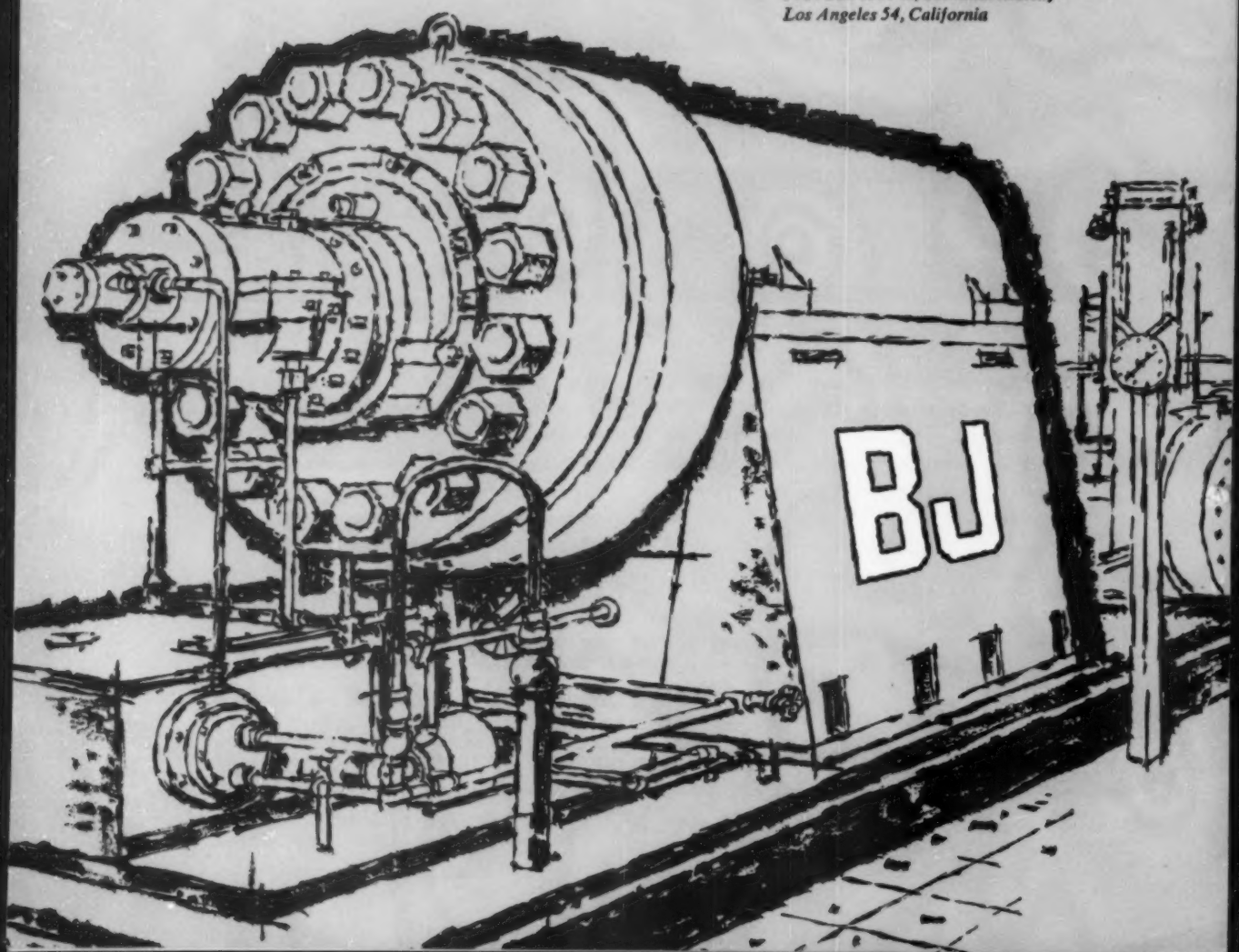
BJ Boiler Feed Pumps

Reliability is the only real "bargain" you can afford in a boiler feed pump. Reliability that comes from the basic quality built into a pump, and the reliability that assures long, continuous performance under all conditions.

At BJ, quality is a full time job. Trained personnel with long experience in building quality pumps are combined with the latest facilities, equipment and special techniques. The result is a line of boiler feed pumps to meet the higher speeds and temperatures, greater capacities and higher pressures required of modern boiler feed service.

BJ Quality does cost less in the long run!

Quality *costs less* in the long run!

Union Bag-Camp Corporation *adds another BJ Double-Case Boiler Feed Pump in their Savannah plant expansion. A total of five of these seven-stage, steam-turbine driven units are now installed.*

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